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THE FOUNDRY

VOL. 16. DETROIT, MICH., MAY, 1900. NO. 93.

The Niles Tool Works, Hamilton, Ohio.

As one of the most prominent firms of tool builders in the world, the Niles Tool Works, of Hamilton, Ohio, possesses features that should interest every mechanic.

The forerunners of this great establishment were Niles & Co., of Cincinnati, and the first tools were built simply to supply their own wants, owing to the difficulty of securing them in the open market. The success of these created a demand for similar appliances in other shops, and thus was launched a department of tool building, the fame of which has reached wherever manufacturing has gained a foothold.

Owing to the cramped quarters of the Cincinnati plant a model establishment was built at Hamilton in 1872, to which many enlargements and additions have since been made. The main foundry, as at present arranged, is 60 feet wide and nearly 450 feet long, and provided with three 30-ton electric

SOME VIEWS FROM THE FOUNDRY OF THE NILES TOOL WORKS, HAMILTON, OHIO.

A Corner of Laboratory, Niles Tool Works, Hamilton, Ohio.

Scenes in Casting Cleaning Department, Niles Tool Works, Hamilton, Ohio.

A MOLD READY FOR DRYING. NILES TOOL WORKS, HAMILTON, OHIO.

MOLDING WITHOUT PATTERN OR FLASK. NILES TOOL WORKS, HAMILTON, OHIO.

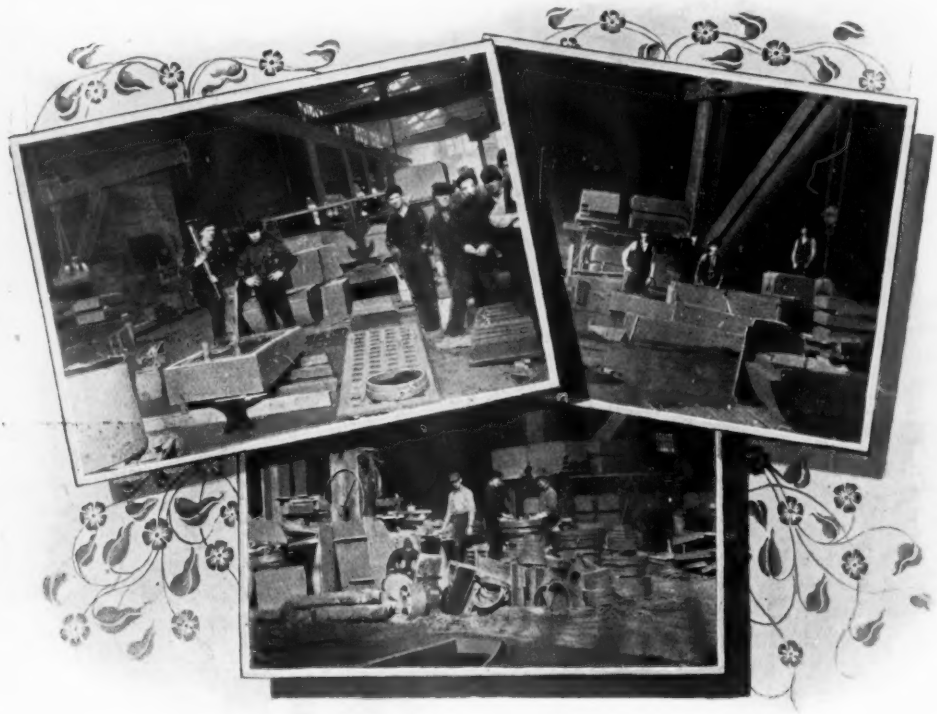
traveling cranes. Besides this space, in which the heaviest work is turned out, there is also molding floors on both sides of this, which cover nearly an equal area. These floors are served by electric cranes ranging in capacity from five to fifteen tons, a track system offering a ready means for transferring iron to all parts.

What will perhaps strike the average foundryman as peculiar, is the small amount of flasks employed for turning out heavy work. Nearly every heavy casting is bedded in the floor, and while in a few instances a cope is provided, still a great many molds for castings, weighing all the way up to thirty tons and over, are simply covered with cores, weighted down and properly secured. Nor do all of these castings have plain surfaces for which flat cores will answer.

It may at first thought appear as if this method of covering molds would cost more than if a flask were employed, and yet there is something to be said in its favor. Give a man a set of core arbors, and the chances are that he will have sufficient cores rammed up to cover the mold for a heavy casting in less time than the molder could ram up a deep flask to do the same thing. When the cost of keeping a large flask in repair, bars burn out mighty quickly here, the cost of moving same in and out of the shop and handling it after it is rammed up, when everything is taken into consideration, there appears to be something to be said in favor of the cores.

The foundries of that section of Ohio are blessed with an abundance of good molding sand suitable for heavy castings. It is a sort of a natural loam, and the molders appear to treat it with immunity, apparently confident that they can treat it almost as they please without any evil results.

The majority of the work of the Niles Tool Works is skin-dried, and of course this is another method that favors the molder and relieves him from worry. There are many foundrymen who boast of their ability to make everything in green sand, and while



COREMAKING DEPARTMENT, NILES TOOL WORKS, HAMILTON, OHIO.

we are forced to admire their skill in this respect we feel that, viewed from a commercial standpoint, they could probably do better and secure a larger output by skin drying a mold occasionally. In other words, much of the time and care which they must bestow upon a green sand mold could probably be dispensed with through the application of a small amount of heat. There is this much about a skin-dried mold, when it comes to heavy castings, it cleans easier and requires less care in its construction than one which is poured without being dried. Charcoal is the only fuel employed for this purpose at the Niles Works.

One of the illustrations appearing with this article shows a method of molding, that for certain castings cannot fail to commend itself, eliminating as it does entirely the item of patterns and flasks. Where castings are wanted of different lengths, and minor changes constantly taking place as in this case, a few core boxes are certainly easier to keep track of than an assortment of patterns.

Briefly described, this mold (see illustration, page 89) is made by ramming up the bed and placing the cores appearing therein in the right position. Afterwards the sides of the mold are rammed up in sections, two of which are shown in place, sand is rammed in behind these, and covering cores completes the job.

The Niles Tool Works, until recently, had nearly all of its castings made by the piece. To the general jobbing molder it would probably sound a little out of order to be told to make a certain casting, and further that the price would be seventeen dollars. We are all acquainted with piece work below the half-dollar mark, but the majority would likely be staggered by some of the figures paid for larger castings. Certain it is, that a molder who lost a casting in which he had twenty dollars at stake would be likely to remember the occasion and its cause.

However, the Niles Works paid the molder fifty per cent for lost castings and full prices if this resulted from causes beyond his control. The crowded condition of the shop and the urgency for castings has necessitated the employment of many more molders and the doubling and trebling of men on a single job. In view of this and the difficulty of ascertaining who is responsible for the loss of a casting when more than one molder has a hand in making a mold, piecework has for the present been largely suspended.

The Story of a Small Job.

It may be taken for granted that there will always be room for improvement in the foundry business. The up-to-date foreman will always have much to learn. The one a notch behind will have still more.

FIG. 1

This is because there is always something new turning up. Something that only trial after trial will develop.

There is more room at the present time for a man to show his ability in a foundry doing small work than in one making large castings exclusively. The small casting makes up in numbers what it lacks in size, and a second saved in the time consumed in molding it may amount to more than an hour chopped off a larger job.

All the improvements that are made, in the foundry as well as in other trades, have for their object a reduction of time, a lowering of the cost of production. Right here is where new methods lay the foundation for more or less trouble between the concern who pays for the improvement and those whose time it is sought to reduce.

Most every molder will give a violent jerk to his suspenders if he is asked to increase his output. I am not saying this as a special reflection on the molder, because other tradesmen are the same way; it is human nature.

Let a foundryman have a certain job, and let him continue to devise means for lessening the molder's work, and he will find it difficult to convince the latter than the one

FIG. 2

making the improvements should be entitled to the greater share of the benefits arising therefrom.

Let us look at the question in a plainer light. Let us say that a molder is paid three dollars a day to produce a certain number of hard blows. The concern who employs him

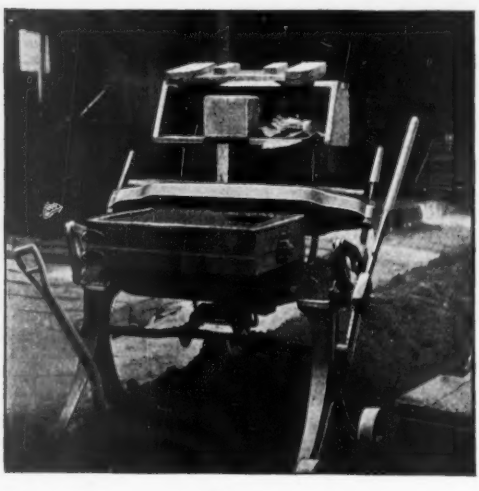


FIG. 3

adopt devices whereby this same number of hard blows will produce twenty-five per cent more castings. Will the molder continue to put in the same number of hard blows? Will he not say that the company is driving him if he is asked to increase his output? Yet he is not asked to give any more muscular energy for the pay he receives than formerly.

The fact of the matter is, that workmen are prone to look only at the quantity of the product and not at the methods whereby it has been made possible. I know of a certain casting of which, a few years ago, six used to constitute a day's work, where the output is now thirty. Still I am satisfied that the man who puts up thirty to-day does not work as hard as a molder formerly did putting up six. Occasionally I meet one of the old-timers, and his remarks

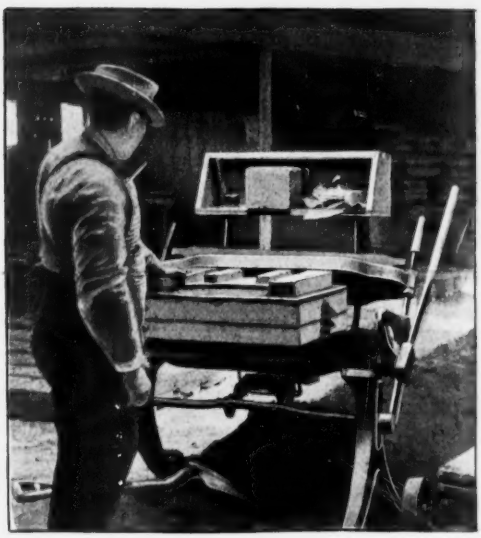


FIG. 4

are something like this: Trade gone to Halifax; look at what a man has got to do nowadays.

Occasionally we will find a whole shopful of men who are laboring under the mistaken idea that their employer is abusing them, because he seeks by improved methods to increase their output. If the price is reduced on certain jobs to reimburse the employer for added facilities the charge is not long in coming that he is reducing wages. Yet as far as earning capacity goes there may be no reduction whatever. The operator may be better off than before, only he does not know it.

A common complaint against a shop in

which a strike or lockout occurs is that "they pay nothing." On a recent visit to Hamilton, Ohio, I heard this charge voiced against the H. P. Deuscher Company, and being afforded the opportunity of looking

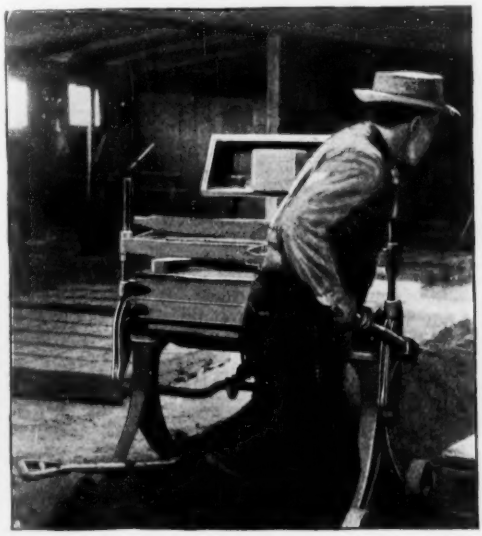


FIG. 5

over the shop and the prices paid for molding, I want to illustrate an example of current foundry practice, as it shows that good paying jobs are often found where none are supposed to be.

The particular piece of work chosen is a sewing machine casting. A general idea of its appearance may be obtained from Fig. 1, which shows the follow-board placed on the machine ready to begin operations.

As the casting is of such a shape that a square flask would necessitate the use of a large amount of needless sand, the blocks seen inside of the flask in Figs. 2 and 3 are rammed up in the mold.

Fig. 4 shows the general appearance of the mold just previous to being rammed as in Fig. 5, a special board, having a projection to indicate the location of the gate, being used for the cope side. I do not know as the word ramming is the proper one to use in this connection, as the sand is pressed rather than rammed; in fact, I believe the makers, the Adams Co., of Dubuque, Iowa, refer to their molding machines as sand presses. There is this much to distinguish the Adams machine from those of the ordinary squeezer type. But one lever is employed; the mere act of pulling the lever forward (Fig. 5) carries the head of the machine to its proper position, and a reversal of the movement clears the mold.

Fig. 6 shows the appearance of the finished mold, the blocks releasing themselves as soon as the flask is removed. A general idea of the shape of the mold can be obtained from a glance at the follow board seen on the machine or flask.

The flask used on this job measures 17½x 22½ inches, drag 2½ inches deep, cope 3½ inches. As the sand is compressed after the flask is levelled off, the finished mold shows less thickness. The price paid for this casting is five cents a piece, and the molder who was working on the job told me that he could average five dollars a day. When it is considered that this man has worked but a couple of years at the trade, this must certainly be regarded as good wages, even half of that sum would not be despised by many having an even greater experience.

This example is one which aptly illus-

FIG. 6

trates that with suitable appliances and a willingness to learn, a young man may in a surprisingly short time become quite as proficient on certain classes of work as the best molder.

An Adjustable Clamp.

We illustrate herewith an adjustable clamp in use at the foundry of the Link-Belt Machinery Co., Chicago. Fig. 1 shows the different parts composing the clamp, the

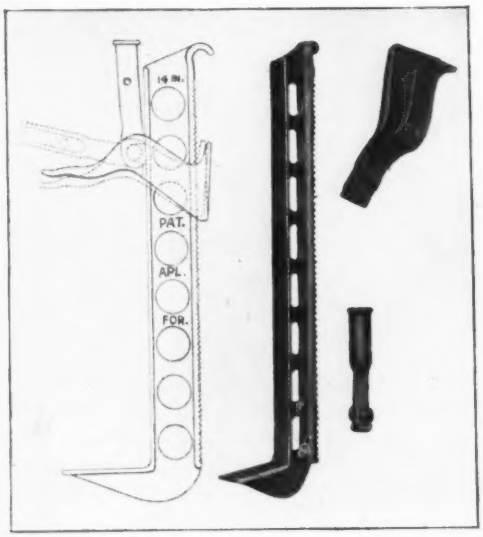


FIG. 1

dotted lines in the drawing to the left indicating the movements of the adjustable toe, which has sufficient freedom to be readily attached to a mold, and yet is firmly and quickly clamped, saving time under all circumstances. It will be noticed that the clamps are so constructed that they may with immunity be left among sand and rubbish on the floor without in any way having their working parts clogged up or injured.

Fig. 2 shows the appearance of a mold

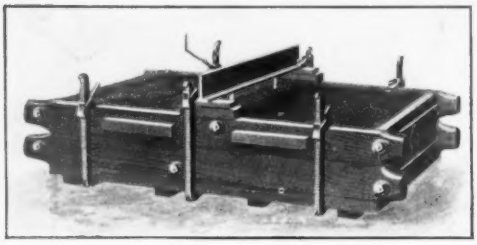


FIG. 2

fastened with these clamps. It will be seen that the same sized clamps holding the mold proper also secure the crossbar, which in turn hold the chaplets in place. Anyone who has had to clamp such a mold will remember the length of time generally spent in hunting blocks and wedges, not to say clamps that would somewhere near fill the bill. The length of time that is saved must be a clear gain to the employer.

In the other illustration, Fig 3, is shown an arrangement whereby the columns of the shop are made to serve a useful purpose.

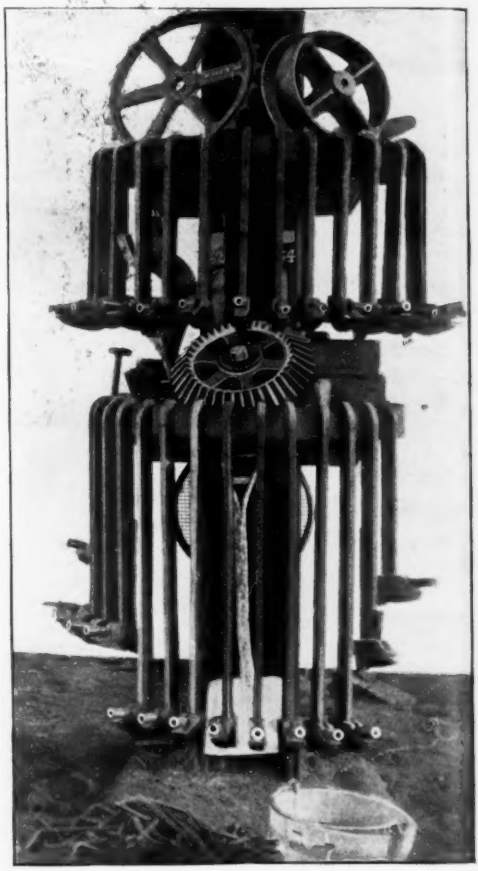


FIG. 3

A set of shelves are provided thereon where the molders may deposit patterns and surplus tools, the outer edge of the shelf serving as a rack for hanging clamps. This is a feature more shops should take advantage of, as a comparatively small outlay will provide a place for things that in the average foundry are deposited anywhere.

We are indebted for the photographs and description of same to Alex M. Thompson of the Link-Belt Machinery Co.

The American Girl.

Statue cast in gold, by The Henry-Bonnard Bronze Co., 432 West 16th Street, New York City. Height 6 ft., weight about 700 pounds. Miss Maude Adams posed for the statue which is to go to the Paris Exposition. The sculptor is Bessie O. Potter.

CAST IRON NOTES.

Devoted to inquiries from Practical Foundrymen on the subject of Melting and using Cast Iron. Address all inquiries to W. J. KEEP, care of The Foundry.

FOUNDRY TESTS.

QUESTION.—We are desirous of obtaining some more information from you. How do you determine the amount of silicon the iron contains by testing it? We send you two bars, one half inch square and the other one inch wide flat. We would like you to test same and let us know the result as to the amount of silicon they contain, and as above requested, tell us how you determine the amount of that ingredient. Further, if two bars are poured from the same iron but of different dimensions, will they vary in silicon, or otherwise? Does rapid cooling destroy the silicon? We think with this information we will be able to make tests and get satisfactory results with any iron that we may mix.

ANSWER.—I am glad you have asked these questions, and will try to answer them plainly. Carbon in iron will always remain in the combined state, and the iron will be hard and white, unless some influence changes it into graphite, when the iron will be gray and soft. Silicon turns hard white iron into soft gray iron. Iron which would be white if cooled rapidly will be gray if cooled slowly enough.

A large casting will cool more slowly and will be grayer than a small casting poured from the same iron, but the silicon will be the same in each. If the silicon is in the melted iron it will be in the casting whether cooled fast or slow.

If the iron runs against an iron chill it may cool so rapidly that the silicon will not have time to change the carbon into graphite and the iron will be chilled white. If it cools very slowly the silicon has a longer time to exert its influence.

To produce the same grayness in a small casting more silicon is needed than in a large casting.

There are other elements in cast iron than silicon, and they modify the influence of silicon, as does fast and slow cooling.

A given percentage of silicon for these reasons does not always produce the same influence.

The founder cares only for the physical quality of his castings, grayness, hardness, size of grain and depth of chill. As we cannot depend upon any given percentage of

silicon to produce a given degree of these physical characteristics, we must vary the silicon to keep these qualities uniform.

Fortunately a given shrinkage accompanies a given physical quality. A measure of shrinkage is therefore a measure of the influence of the silicon present in the casting measured, but not the influence of the same silicon in another casting of a different size from the same iron.

If you are making castings of a certain size which have a certain quality that is satisfactory, make a test bar of the same iron and measure its shrinkage.

If you maintain this shrinkage you will maintain a uniform, physical quality. If the shrinkage is greater the castings will be harder, the chill deeper and the color lighter.

Increase silicon by increasing the iron of your mixture that contains most silicon and the shrinkage will return to your standard. If the shrinkage is less, you can increase the cheaper irons until it again reaches the standard.

You do not need to bother about the percentage but about the influence which you see in your castings.

If you want to approximate the percentage or rather know what percentage a chemist would expect to produce such physical characteristics, you can use a table of shrinkages of irons of known silicon contents, and by finding the shrinkage of your test bar you can see what silicon in that case produced a similar shrinkage.

This would be as correct an approximation as you would be likely to get from chemical analysis.

You sent me a test bar ½ inch square, asking me to test it. The test is to measure shrinkage. You must place the test bar between the same chills that were used in the mold and measure the shrinkage yourself. I cannot measure the shrinkage, because the bar must be measured in its own chills.

I notice that you have ground the sides of the test bar. The sand should be rubbed off, but the center of the bar should never be ground.

Strength does not depend upon the chemical analysis but depends upon the character of the grain.

By experimenting you will find which mixture of your irons gives you the strongest castings. I wish that you would practice what I have suggested and then write me again, giving results, and tell me what I can do to make the matter more clear to you.

Since writing the foregoing I have received a reply to the above, in which the writer says:

"After reading your letter carefully I find that we are working upon the same lines that you are. In the first place, we take each iron separately; we make a test so as to determine the percent of silicon it contains, then combine the whole to obtain the desired results. I am also preparing a key by the shrinkage of each iron separately; for illustration, if an iron, we will say No. 1, from a crucible test shows a shrinkage of .125, I take it by that the iron contains 3.25 per cent of silicon, and so on down the list of the various kinds of iron. By the increase of shrinkage we decrease the percent of silicon. By this method it enables us to govern our mixtures very satisfactorily."

Solid Castings.

BY H. FISHER.

I have read so many excellent articles on the subject of shrinkage that this may appear to be nearly threadbare, yet perhaps a few words more may be of interest. Our work is marine and general jobbing castings of the heavier class, and in weight run from a few pounds up to twenty tons. Of the latter class, we have an order for fourteen Corliss cylinders, six of which we have cast successfully. I would give a description of our method of molding these, only that I would be going away from the subject of shrinkage in doing so.

When I was a boy we used to churn everything that was the least bit heavy, but with me at least this is out of date, unless the casting is very thick with no cores, such as large rolls, etc., and even then, we put a large feeding head on them, and after pouring cover these with charcoal and let them go. The cylinders I referred to weigh 44,000 pounds each, and there are some very heavy sections in the head and bottom flange where the metal measures ten inches through. We run these castings from the top and chill our gates and risers right after pouring, and the first six have finished perfectly solid. We depend on the expansion of the cores keeping up the shrinkage.

In some shops, they usually churn heavy green sand work, but not their loam work. We make green sand castings as high as 22,000 pounds in weight without churning. Several weeks ago we had to break a large blowing cylinder head weighing 17,500 pounds, which was molded in green sand and not churned, the metal being eight inches thick in some places, and we found it perfectly solid throughout.

It has been my experience that large castings full of cores are not only better without churning, but are better without large risers, as small ones can be chilled much quicker. On one occasion I had charge of a shop in San Francisco that made a specialty of small ice machines. When I took hold the superintendent drew my attention to the fact that their ammonia cylinders had always given them more or less trouble through leakage at the base of the jacket core, shown in sketch at A, Figure 1. I had one broke up to see what was the trouble, and found there was a heavy section impossible to remove, and that while the metal was solid, it was so open grained that the ammonia would work through it. I conceived the idea of using a chill, as shown at B, Figure 1, to overcome the trouble. We broke a casting

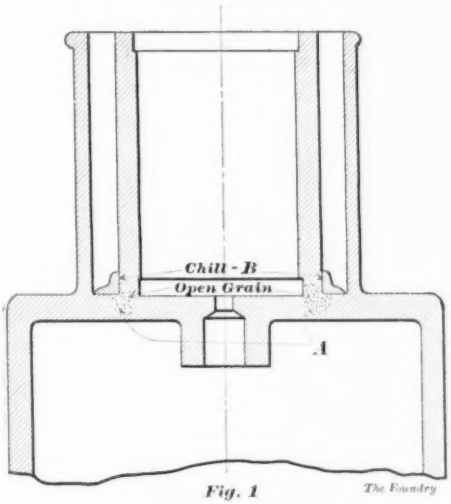


Fig. 1 The Foundry

Ammonia Compressor Cylinder and Frame.

up to see the effect of the chill and found it closed the grain of the iron for about one-half inch at the outside corner of the cylinder, and as the casting was an inch thick, the chill did not effect the bore of the cylinder in the least.

We made the chill in two pieces and rammed it up in each half of the jacket core, and by putting a little paste where it touch-

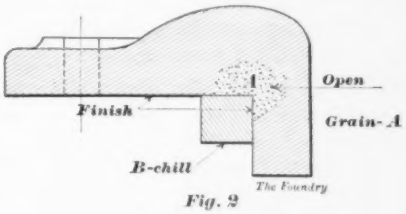


Fig. 2

Crosshead Guide.

ed the sand, we found it remained in position and sufficiently secured. Of course, the chill had to be left in the casting, but as it was only one-fourth inch thick, and a man could make a set of chills in a few minutes, this amounted to but little. I don't want to be understood as claiming to be the first one to use a chill for this purpose, although I never saw it used or heard of the method being employed, so that with me, at least, it was original.

Since then I have used chills for several jobs in order to secure a close grain at certain points of the casting. Where I was foreman some time ago we were making some guides for a marine engine, a section of which is shown at Figure 2. We cast the machined side down and they finished up without a speck in the face, although at A, Figure 2, the iron was open grained. And it is almost impossible to make a heavy casting close grained at certain points, and as the government inspector would not accept them in that condition, I decided to use a chill in the corner B, Figure 2. This overcame all trouble, and as we used soft iron the machinists had no trouble in finishing them.

The Cupola and its Workings.

In reply to P. Duncan & Co., I will say that the troubles of the foundryman are many, and the beautiful theories advanced by experienced and inexperienced men inside and outside of the foundry if published in book form would make the Encyclopedia Brittanica look like 30 cents. We have all listened to, and pondered over them, and where the ideas advanced have appealed to us, have experimented with them, and in

many cases found them good. We cannot lose anything by listening to all, from the skimmer boy to the foreman. Your "electrical expert" is probably correct about the length of the pipe, but his electrical theory is open to discussion. There is no inclination or intention on the part of the writer to enter into that discussion.

The length of the pipe is not of so much importance as the capacity of it, yet a greater length of pipe gives a greater storage capacity. If you can locate your blower 75 feet from the furnace, or if you can make your pipe 75 feet long without having too many bends in it (which are always an objection because of the friction), and at the same time construct the pipe several inches larger than is necessary, for its entire length, except where the cupola and blower connections are made, you form a receiver which will aid in giving what the melter is in greatest need of, viz., a regular blast, not only in volume, but also in pressure. The enlarged pipe is also a great help at all bends, as it allows the wind freedom without a great deal of friction. When the several charges fall in the cupola, there is an immediate and intense strain on the blower. The ease with which air is compressed in the enlarged pipe saves the blower machinery, and it is no more difficult to maintain a ten to fourteen-ounce pressure with a large pipe than with a small one. Presuming that your blower is ample for the work required, your troubles can be overcome provided your furnace is right, and also that your melter knows his business. In many foundries a strong, active man is made melter, and continues as such all his life, without at any time getting a first-class heat, that to save his life he could not duplicate. This man does not get extravagant pay, but he probably gets more than he is actually worth, for the purpose for which he is employed. You pay a molder good wages to make good work, but the melter has a hand in this deal, and the money that you have paid for time, material, etc., etc., goes up in prismatic colors with the beautiful gases from the furnace, and following them, a unique collection of foundry adjectives, that when debited to your account will have a tendency to make you wish that you could spend the balance of eternity in the old foundry cupola. A good melter is as important to you as is a good blower or cupola, and will cost you an equal amount of good dollars per day. Your tuveres must be large enough to admit sufficient air for your heats, and if melting with coke entirely, two rows of tuyeres about 17 or 18 inches apart are positively necessary. With a coal bed, yon can manage with one row of tuyeres, but this one row must have the same capacity as the two rows together, used for all coke. You may be using too much fuel in the bed. This will hold the stock above the melting zone, and while it will fuse there, it does not come down either hot or fast, and you must keep plugging up the furnace at intervals all through the heat. When a cupola is working right, the iron will come down in from three to nine minutes after the wind goes on, and will flow continuously until the cast is off. This is being done in some foundries, and there is no reason why it should not be done in all.

A Cheap Core Mixture.

BY L. A. LELAURIN.

Referring to a question on this subject in a former issue of THE FOUNDRY, will say that the cheapest core mixture I can obtain in this part of the country (Pine Bluff, Arkansas) is of the following composition by measure: Good sharp or river sand twenty parts, new molding sand three parts, cotton-seed meal one part, pulverized rosin one-half part; use this of about the same dampness as molding sand.

We have used this core sand mixture for twelve years, and the cores will neither sag nor blow. Have left oil box cores in the molds for three days without any injury resulting therefrom, and the same mixture has also been used for cylinder cores and the like. Have made cores three-quarters of an inch thick by eight inches wide and ten inches high for splitting counter balance of driving wheels, and never experienced any trouble. As cotton-seed meal costs but $15.00 per ton here, while the cheapest flour is $3.50 per barrel, it will readily be seen that the former is the cheapest. Rosin costs us two cents per pound delivered here.

That individual known as the cupola man should be looked upon as a mechanic and not as a laborer. A good cupola tender must use his brains.

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We want to obtain examples of current foundry practice. Photographs, drawings and descriptive matter, showing just what is being accomplished in the foundries of to-day, will be cheerfully paid for.

We can not furnish a continuous set of back numbers beyond the current year.

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Trade Outlook.

Through concessions from both sides, the machinists and their employers have agreed to continue work as before, pending arbitration of the points at issue, and this disturbing feature of the industrial situation has been removed without the loss of time and money that a serious struggle would entail.

Nothing could have been more unfortunate than to have had a damper placed on the present activity in the form of a general labor disturbance. While capital is always willing to enter new fields where returns are promised, it is also very timid in times of excitement.

The settlement of the Frick-Carnegie quarrel and the formation of a new Carnegie Company, is regarded as having exerted a favorable influence upon the iron trade. It has also tended to show the control which the heavy producers have over the market.

There are several reasons for believing that many foundries are operating their works on the from-hand-to-mouth plan. The many small orders for quick delivery tend to confirm this suspicion. At all events, nothing is surer than that the consumers of iron are guarding against any retrograde movements through buying only enough to meet their immediate needs, at, at most, enough to supply them for a month or two. Leading buyers declare that the market has yielded but little, and that they are compelled to pay about the same prices as early in the year.

The Chicago Convention.

The fifth annual meeting of American foundrymen which will take place in Chicago June 5, 6 and 7, under the auspices of the American Foundrymen's Association, will make that city a Mecca towards which many a melter of pig iron will wend his way.

Nor will a trip to the popular Windy City be a waste of time, since this place contains a greater number of foundries within its borders than any other city in the world, the variety of castings produced corresponding to the number of establishments. The practical foundryman who visits Chicago will find more than enough of interest to occupy his attention, and it is hardly possible that one could fail to obtain ideas that would prove of value, no matter in what particular branch of the trade he is engaged.

Among the largest foundries of Chicago are the two great reaper works, known as the McCormick Harvesting Machine Co. and the Deering Harvester Co., whose foundries are famed far and wide for innovations in practice and extent of specialization.

In shops doing heavy work, Fraser & Chalmers and the Gates Iron Works have frequently contributed examples of high-grade castings that have excited universal admiration. The National Malleable Castings Co.'s plant at Chicago is one of the largest in the country, and one of the first establishments of this kind in the west. The Link-Belt Engineering Co., in addition to conveying machinery, of which it is a pioneer manufacturer, also turn out heavy castings of various kinds.

The customary rate of a fare and a third for the round trip will be granted by all railroads on this occasion, and the few days instructive outing should be taken advantage of by every foundryman.

Getting Close to the Limit.

There has been more friction caused of late by the molders' demand, in certain localities, that nothing but members of their organization should be employed than could possibly have been caused by any demands in other directions.

A case in point is a late occurrence at the foundry of the Brown & Sharpe Mfg. Co., Providence, R. I., where a molder, disliked on what might be called general principles by the members of the Molders' Union, was given employment. Upon hearing a complaint the management promised to investigate the charges against the obnoxious molder, which was done without finding any reason why he should be dismissed. The Brown & Sharpe Company took the ground that as long as the man done his work faithfully and attended his own business, any ban which an organization might see fit to place upon him should not interfere with his employment.

This is the broad ground upon which the Brown & Sharpe Company looked at the question, and one which it must be admitted is entirely disinterested. Having always treated their workmen fairly and equitably, they refused to bow to any personal animosity shown towards any individual in their employ. About twenty-six molders out of about sixty quit in a body in an attempt to bring the employers to their terms.

There is no financial advantages involved to either side, and the occasion affords an example of the employers having the courage to stand by principles they believe to be right, irrespective of any temporary inconvenience or loss.

Another instance showing the annoyance to which employers are sometimes unnecessarily subjected occurred at Springfield, Ohio, where the molders of the Springfield Foundry Company left their places because the management engaged a foreman from out of town instead of promoting one of their own workmen. This action upon the part of the men is all the more peculiar since the new foreman was a member of their own organization and if we remember rightly was released from a similar position with another foundry because he was supposed to be acting too favorable towards those in his charge. It is only fair to state that the national officers of the Molders' Union refused to sanction the action of the local and ordered the men back to work. A little cool-headed consideration of the whole case should have convinced the molders, in the first place, that they were wrong.

Burned Iron.

BY EDWARD KIRK.

Burned cast iron presents the most varied as well as the most deceptive fracture of all the irons the founder has to deal with. The variations are due to the extent to which the iron is burned and also to the conditions under which it was burned. The deception is due to the changes effected in the crystalization of the iron by frequent or prolonged heating.

In a grate bar, we may find near the center a small crystal of a light bluish cast, and near the ends a large crystal with a dark blue cast. This is due to the center having been subjected to a greater heat than the ends. In heavy retorts, etc., we find a large crystal and open iron, presenting many of the characteristics of fracture in a very soft No. 1 pig iron. And in fact, in all burned iron, not burned in contact with fuel, we find in the fracture the characteristics of a soft iron.

The mistake commonly made by founders and melters is in judging this iron by the fracture, which in reality indicates nothing as to the quality of iron that may be melted from it. Grate bars are frequently broken and the center condemned and thrown in the dump, while the ends are melted, simply because the fracture near the end indicates a soft iron. Pieces of retorts and other burned castings are melted for the same reason that should be thrown away.

All burned iron should be judged by the external general appearance, and not by fracture. By general appearance is meant the entire casting should be considered and not certain parts of it, as is too frequently done.

In burning away the surface of a grate bar near the center, the ends are subject to a prolonged heat, of a degree lower than in the center, but sufficient to destroy the iron; although none of it may have been burned away near the ends and the external appearance gives no indication of the iron having been injured, the same rule applies to a greater or less extent to all castings, parts of which show indications of having been burned.

This principle is frequently better understood by junk dealers than founders, and in sorting scrap unprincipled dealers break off parts of castings showing external evidence of having been burned, throwing it in the burned iron pile, while that showing no evidence of being burned is thrown in the good scrap to be sold to founders, who judge scrap by fracture only. Retorts, pipes, salt kettles, etc., are broken into plates, slabs or pieces, to destroy their identity, and thrown in a pile to rust before being placed with good scrap, a few pieces to the ton, to be sold as good scrap. This is one of the tricks of trade that founders have to look out for, to avoid unknowingly melting burned iron for their castings.

Burned cast iron in all cases, when melted in a cupola, produces a hard iron. The degree of hardness depends upon the extent to which the iron has been burned, from that only slightly burned, a hard grey or mottled iron may be obtained. From that burned to a greater extent, a white iron, and from that burned to a still greater extent, a very small per cent of white iron, with an excessive amount of slag. These three grades may be found in a promiscuous lot or pile of burned iron and when melted alone, the product is generally a white iron, with a large amount of slag. The slag may boil in the cupola and stop melting or may flow from the tap hole with the iron, and in some cases cannot be distinguished from it, until it has cooled to a considerable extent.

We have seen a large ladle full of this slag carried to the mold under the impression it was iron, and the mistake not discovered until an attempt was made to pour it, when it was found the slag could not be held back with a skimmer and when dumped into the pig bed and cooled, it was found there was only a few pounds of iron in the bottom of the ladle; all the remainder being slag, although it had all the appearance of molten iron, as it flowed from the tap hole and spout.

The melting of an entire heat of burned iron is generally a very unsatisfactory operation, and when once tried is seldom undertaken again by the same founder.

The nature or quality of an iron when burned is completely changed, and when melted with the same grade of iron from which it was made, does not enter freely into combination with it. The change effected varies with the extent to which the iron is burned. That only slightly burned enters more freely into combination with a soft iron than that badly burned. When melting this iron with a soft iron, we may find it in castings combined only to a limited extent with the soft iron, and forming hard spots, or we may find it in thin plates, sandwiched in between two thin plates of soft iron. And in heavier castings, in nodules, separate and distinct from the soft iron.

More commonly, it enters into combination to some extent and forms hard spots, and hard spots in castings, especially in comparatively heavy castings, can more frequently be traced to burned iron than any other cause due to the iron.

To prevent hard spots from this cause, scrap should be carefully examined for burned iron before charging, and all suspicious looking pieces thrown out, regardless of fracture indications. It will be found more economical to consign all such iron to the dump at once, than to save it for future use.

WROUGHT IRON SCRAP.

In a promiscuous lot of old scrap are to be found many pieces of wrought iron, such as bolts, nuts, stove rods, etc. This iron is totally different from cast iron and when melted produces an iron that does not enter freely into combination with cast iron. This is more especially the case if the wrought iron has been burned or heavily coated with rust.

It is frequently claimed that these small pieces of wrought iron can have no injurious effect upon a large body of cast iron, but they certainly do. Their effect can frequently be noticed on iron in the molten state, as it flows over the spout and drops into a ladle.

The presence of such iron is indicated, to the close observer, only for an instant, as the iron flows through the spout, by a bright shower of very small sparks which disappear the instant the iron falls into the molten iron in the ladle.

In the ladle, it may enter into combination with the cast iron, if in very small quantities. If it does not so disappear, its presence is indicated in castings by hard spots, which may occur in flanges or parts of castings to be finished, and cause the casting to be condemned.

To prevent hard spots, all such iron should be broken from the scrap and thrown out, as should also all pieces of steel, when only a soft even iron is desired for the castings.

Such iron has a higher market value than cast scrap, and it had better be sold than melted.

Shrinkage, Blowholes and Disintegration.

BY N. W. SHED.

In the March number Mr. Roxburgh throws some light on the ever interesting shrinkhole and blowhole. The blowhole is bad enough as he is, and why should Mr. Roxburgh make him worse by calling him by the hard name disintegration?

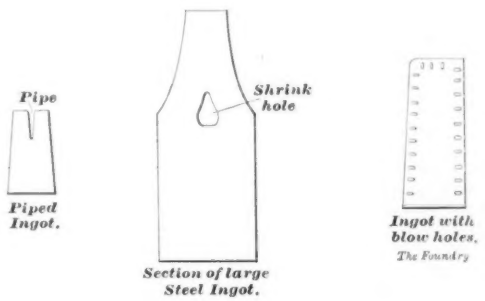
We see castings that are cracked, rusting and falling to a pile of dust; that is disintegration. But a casting with many blowholes has stood up to its work for years, getting many hard knocks; surely there is no disintegration in this case. Let us give up the long name and call one a shrink hole and the other a blowhole. Our friend thinks they go hand in hand, that one comes with the other; but a little study will show that a shrinkhole is no more like a blowhole than a cave is like a soap bubble. It is true they are sometimes found near each other, but their nature is very different.

Let us look at the shrinknoles first. We naturally would expect to find them in metal which shrinks the most on cooling. We therefore find them in the castings made of dense white iron for malleable work. Wherever a sharp T angle occurs we can look for a shrinkhole at that place. In heavy gray castings, like pulleys, we can see them where the arm joins the rim.

In steel ingots the shrinkhole makes a long cylindrical cavity called a pipe. In the big ingots that Mr. Roxburgh mentions the top of the pipe is closed over, but a large pear-shaped cavity is formed, making a big shrinkhole near the top of the ingot as illustraded in the sketch. It is a rule that the shrinkhole goes with the closest grained and densest metal. The numerous physics added to metal to make it solid generally increase the size of the shrinkhole or pipe. The shrinkhole is seen on the surface of the casting; sometimes it will make additional mischief by coming out on the other side of the T angle. Again the surface of the shrinkhole is smooth, sometimes covered with little teat like points.

Now let us look at the blowholes and note the difference between them and shrinkholes. We naturally would expect to find them in metal which shrinks the least in cooling.

In wild gassy metal they are abundant. Loose spongy metal is generally caused by blowholes. We will see them in poorly melted air furnace metal and in steamy cupola metal. Carbon steel is often affected by them and many pigs low in silicon and coarse grained will show large and small blowholes. The blowholes are usually below the outside skin and will be found along the sides of the casting and at the top; they will range from the size of a pinhole to the size of an egg. A blowhole is a frozen gas bubble. The gas may vary, but the bubble remains the same. A glass of stagnant water will show how a blowhole may be made. Notice along the sides of the glass the tiny



bubbles, some of them running together to form larger ones. Now freeze the water and you have the bubbles imprisoned, and your piece of ice will closely resemble a blowhole casting.

We have seen that the shrinkhole is one thing and that the blowhole is another thing. If we try to cure a shrinkhole we may form blowholes; if we try to cure blowholes we may form shrinkholes. Can some readers of your paper give their cures for shrinkholes? Can some give their cures for blowholes? Can someone tell why an air furnace casting will be freer from shrinkholes than the same metal melted in a cupola?

The answers to these will be of most practical interest and perhaps the theory men would like them too.

It takes less fuel to melt iron in the office than it does in the shop.

There are but few foundrymen who will tell the truth about the amount of fuel they use in melting iron.

Annealing Malleable Cast Iron.*

BY GEORGE C. DAVIS, EASTON, PA.

Two statements have been frequently made concerning the changes resulting from annealing that have not attracted the attention they deserve. The first is that malleable iron gains in weight, and the second is that it expands about ⅛″ per foot. Now, the question naturally arises, Is there actually any expansion, or is it merely concretion or building up of the castings from the surrounding packing? Some thin castings were given a decarbonizing annealing in mill scale packing in a very hot oven. The results are given in table No. 1, the weights being stated in grams:

Table No. 1—Showing Gain in Weight.

Hard Iron.	Annealed.	% Gained.	2d Anneal.	% Gained.
40.1575	42.4900	5.81	42.5460	.13
44.8700	47.5465	5.96	47.5885	.09
38.4440	41.0430	6.76	41.0885	.11

We deduce from these figures that, under these conditions, there is an average net gain of 6.29%, or, allowing for loss of carbon (approximately 3.40 in this case), that there is an actual concretion of 9.69% of the weight of the casting.

Next a number of small castings were annealed in a packing not containing any appreciable amount of iron. Sand was the packing used, and the results are given in table No. 2:

Table No. 2—Showing Effect of Annealing in Sand.

Hard Iron.	Annealed Iron.	% Loss.
72.657	70.458	3.02
85.324	81.7810	4.15
75.4924	71.0820	5.84
41.6035	39.2855	5.56

These castings were covered with a thick, soft scale, and part of the loss was due to this, while an examination showed that there had also been a partial oxidation of the carbon. The pot was a small one and the castings rather more exposed to the action of the air than they would have been in a larger pot.

For a third experiment a set of bars, each 12″ long by 1″ wide, and of different thickness from ⅛″ to ¾″, were cast from the same heat. There were four bars in each set, and the results are as uniform as could be expected. I selected in each case the bar showing the nearest to the average, and the results are given in table No. 3. The first line represents the annealed bar and the second the unannealed in each case. The dimensions are given in inches:

Table No. 3—Showing Expansion.

	Length.	Breadth.	Thickness.
⅛″ Bar	11.832	1.050	.143
	11.768	1.037	.132
¼″ Bar	11.930	1.031	.267
	11.784	1.015	.254
⅜″ Bar	11.927	1.043	.392
	11.757	1.020	.382
½″ Bar	12.093	1.021	.509
	11.969	1.000	.497
⅝″ Bar	11.942	1.032	.633
	11.742	1.007	.615
¾″ Bar	11.964	1.030	.749
	11.769	1.005	.732

In table No. 4 I have given the figures showing increase in weight and diffusion of carbon on the above bars. The iron analyzed, silicon .60, sulphur .047, and total carbon 3.23, except in the case of the ½″ bars, which were poured from another ladle, and contained 3.18% carbon.

Table No. 4—Showing changes in weight.

	Unannealed.	Annealed.	Gain %.	Loss Carbon.	Concretion.
⅛″ Bar	204.9	211.6	3.27	2.90	6.17
¼″ Bar	377.8	384.6	1.80	1.97	3.77
⅜″ Bar	555.1	561.6	1.17	1.43	2.60
½″ Bar	735.2	740.2	.68	1.28	1.96
⅝″ Bar	882.5	890.1	.86	1.27	2.13
¾″ Bar 1068.8		1076.4	.71	1.18	1.89

An examination of these tables shows that the changes result from complex causes. Taking the extreme cases, the ⅛″ bar increased in length about one-third as much as the ¾″ bar. The cubic contents of the ⅛″ bar, based on the above dimensions, are 1.61 and 1.776 inches, a gain of 10.29%, while the concretion was 6.17%. In the ¾″ bar we obtain 8.657 and 9.23 or an increase of 6.60%, while the concretion was 1.89%. Now, in the first case the increased volume appears to have been largely due to concretion, while in the second case the remaining graphitic carbon may be the cause. In the white iron practically all the carbon is in combination. During the annealing this carbide is decomposed and the carbon nearly all removed,

*Read at the March meetings of the Foundrymen's Associations.

while in the ¾" bar two-thirds of the original carbon remains as graphite. It should be noted that the measurements taken on the light bars cannot be so reliable as those on the heavier sections. The reason for this is the warping of the light sections during annealing. The carbon determinations were made on samples taken from a cross-section in the center of the bar.

Just what reaction occurs between the carbon of the casting and the iron oxide of packing there is not sufficient data to determine, but in all probability it is complex. We know that considerable carbon oxide escapes from the pots during annealing, and that both ferric and ferrous oxides are present in the packing. A comparison of the results in tables No. 1 and No. 3 shows that the concretion is greater if the annealing is done at a higher temperature. This illustrates the difficulty in making any general statement covering the case. All we can safely assert is that the carbon as it diffuses reduces the adjacent packing, which at the annealing heat welds onto the casting.

Table No. 5—Diffusion of Sulphur.

	White Iron.	Annealed.
⅛" Bar	.047	.072
¼" Bar	.047	.066
⅜" Bar	.047	.060
½" Bar	.047	.058
⅝" Bar	.047	.062
¾" Bar	.047	.058
¾" Bar, outside	.047	.082
¾" Bar, inside	.047	.046

These results show that sulphur diffuses, and, like carbon, it varies with the cross-section of the casting, other conditions being the same. That the gain in sulphur is near the surface is shown by the results on the ¾" bar. While the center remained unchanged, the outside sample taken 1.50" increased .035. It will probably be a surprise to many that there is so large a gain in this element. Much of the packing is made from mill scale, from common grades of wrought iron. This was originally made from forge pig containing .10% or often more in sulphur. In the heating furnace the muck bar is exposed to the gases of combustion and a further absorption takes place. Samples of mill scale from different works gave an analysis of .17% and .26% for wrought iron scale, and .061% and .084% for steel scale. In the decarbonizing annealing of thin castings it is necessary to have a packing as low in sulphur as possible and free from foreign matter. A pitted surface will often result from poor packing caused both by the diffusion of sulphur and small particles of foreign matter becoming imbedded in the iron that builds up the casting. In the case of castings that are to be polished or plated, this pitted surface is objectionable, as it renders the finishing operations difficult. Iron ores very low in sulphur can be obtained, but the present high price of iron is almost prohibitive. Annealing in ore requires rather different treatment, as the ores are chemically more active and the castings lose, rather than gain, owing to oxidation of the iron. Laudig (Trans. Amer. Ins. Mining Eng.) speaks of this fact in connection with the reducibility of ores in a blast furnace, and has shown that there is a wide difference in the reducibility of apparently similar oxides of iron. The length of these test bars in these experiments was measured on an improvised scale. This was made by cutting a 2-inch micrometer in half and bolting each on an iron frame, so that at zero the distance was 11¾". As the micrometer was graduated from 1" to 2", we were thus enabled to read any variation between 11¾" to 12¾".

DISCUSSION BY RICHARD MOLDENKE.*

Mr. Davis presents some interesting matter in his paper, and I depart from my usual custom of refraining from discussing "malleable," on account of the various statements made recently concerning it, which will in time react upon the manufacturer to his material disadvantage. The expansion taking place during anneal is well known and allowed for in making the patterns; but the fact that under certain conditions there is an increase in weight is not generally known outside of those well posted in the trade. It may be taken as a general rule that the contraction of the chilling irons used for "malleable" is ¼-inch to the foot. In the anneal an expansion of ⅛-inch to the foot takes place, the net result being the ordinary contraction allowed for gray iron. Patterns are therefore made in the usual manner, the special art of the "malleable" pattern maker being shown in the gating, chill arrangements, etc.

The contraction and expansion in "malleable" are not regular by any means, as the results of thousands of measurements have shown me. The reasons would seem to lie in the great differences due to: 1, slight changes in the chemical composition; 2, casting temperature changes; 3, shrinkages in

*Presented at the March meeting of the Pittsburg Foundrymen's Association.

the interior of the work. The test bar of "malleable" which does not show some interior shrinkage planes at right angles to its length and is a rara avis. You will please note that I use the term "shrinkage" for the unsound portions produced in the casting during the act of setting, while the reduction in length is designated as the contraction; for just look at the expansion of cast iron under heat a moment. Even with the imperfect knowledge we have on the expansion of metals under high temperatures, we know that a piece of cast iron increases about 1-60 of its length in heating from ordinary temperatures to the melting point. Reverse this and we see that a casting left free to contract in the mold will lose roughly 1-5 inch to the foot. It would seem then that which is usually called shrinkage is a simple contraction due to cooling.

To return to the subject. The contraction in the "hard" casting may vary from a little over ⅛-inch to nearly 5-16-inch. In the anneal this may or may not be brought back to the exact ⅛inch. A long malleable casting can therefore show some unexpected features. The remarkable change in the casting due to the annealing process will some day be more fully understood. My own observations have been that the removal of the carbon in the skin is but a small matter when compared with the interior change of combined carbon to what Prof. Ledebur has called "temper carbon" (temperguss—malleable casting). A malleable casting of the proper composition should contain no graphite strictly speaking. The carbon is not crystallized, but is a soft amorphous variety similar to lamp black. If caught in the first stages of formation it may be readily removed with a needle when under the microscope.

How the carbon leaves the skin of a casting during anneal is something we are not acquainted with sufficiently as yet, and in furnace iron but little leaves it anyhow. A piece, say, ½-inch thick has the full amount remaining in the center; though cupola iron, requiring a much higher annealing heat, will necessarily have the loss in carbon accentuated somewhat. I have always noticed that when a heavy piece of "malleable" has not annealed properly, there is also very little expansion—a fact easily verified by trying to anneal a heavy piece of cupola iron at furnace iron temperature. One interesting point may be stated here which shows that if the carbon is removed by outside agencies it can only be carbonic oxide with but very little carbonic acid. I have repeatedly found a thin layer of lamp black on partly annealed castings when so packed in air tight receptacles, removed from all oxidizing influences, that only the little air present in the first place could act upon them.

To sum up: The change from the dense iron carbides of the hard casting to the open malleableized structure after anneal means the exertion of a powerful expansive force creating inter-crystalline spaces for the disposal of the temper carbon which would otherwise have no place. The expansion of malleable is probably due to these forces and not to iron added from the scale.

I am inclined to take issue with Mr. Davis on what he calls the concretion of malleable castings. If he can really gain about 6 per cent of iron during the anneal he will make our gray iron founders envious for he really recoups himself for the greater part of his melting loss. Now, that a casting can actually weigh more after the anneal than before is a fact; but I have always considered it an unfortunate one when I met it, for in my estimation the added weight is not due to iron welded on from the scale, but to the oxidation of the casting itself, which means weakness. A glance at Table 1 of the paper shows this. Why was only 0.10 per cent of iron (?) added to the second anneal of a piece which gained 60 times as much from the first? By the way, 6⅓ per cent added to the weight of a casting is quite an appreciable quantity. Too bad that the dimensions of the pieces are not given so that the added thickness might be calculated.

Now as to the next point of difference: I may as well state frankly that every carbon analysis of malleable castings which I have seen published is unreliable. I was once given a piece of malleable analyzed by two well known chemists, one of whom found .27 total carbon, the other 3.99. Both results were incorrect, for one took his sample from the skin, the other from the center of the fracture. In fact, an absolutely correct analysis cannot be made, though it should approximate the truth very closely. I will explain what I mean, by one example. A piece of ⅝-inch "malleable," ends broken on, was placed in the shaper and 1-16-inch cuts taken off. The first cut ran 0.16 total carbon; the second 0.65 per cent; the next 1.84

per cent, the next 3.97 per cent, and the next 4.05 per cent. The hard casting contained 4.08 per cent total carbon. On the face of this, of what good is an analysis of "malleable" showing a total loss of carbon due to annealing unless the whole of a sample bored through the test piece is used for the determination? Boring a lot of holes, mixing the drillings, and selecting samples simply will not do. I am afraid, therefore, that the figures given by Mr. Davis incline toward too great a removal of carbon, and the assumption of a loss of 3.40 per cent is far too high a guess.

When Mr. Davis speaks of the diffusion of carbon in annealing I think he comes nearer the real truth of the process than he may be aware of. In my experience with over 100,000 tons of malleable castings I have gained a wholesome respect for oxygen, as you may have observed in my writings on gray iron. Just try to anneal a piece of gray iron in the regular process for "malleable" and note the beautiful banded "calico" structure of the rotten specimen of iron that comes out. Now, here is a good example of oxygen getting into and ruining a piece of iron with nearly 4 per cent carbon. Why did not the oxygen take the carbon and leave the iron alone? Well, it did not; and here I have always had a lurking suspicion that once oxygen got into iron it was mighty hard to get out again. What then becomes of the universally accepted theory that oxygen enters the malleable casting to remove its carbon? It always seemed to me that carbon diffusing out did have some chance, for when oxygen does get into a malleable casting we at once recognize its effect by the white crystalline rim of "burnt" malleable iron.

I heartily agree with Mr. Davis on the sulphur question, though I was seldom troubled with it, having a better grade of "scale" to deal with. His results would indicate that sulphur can readily infuse into the iron but cannot diffuse out, varying in this respect from Mr. Campbell's well-known experiments on steel.

Mr. Davis' interesting paper shows us how little we really know about the internal economy of our beloved cast iron, and incidentally what a fascination it is to delve into the mysteries of even so simple-looking an article of our daily life.

Steam Metal.*

Steam metal is a name applied to the copper-alloy used in the manufacture of steam goods. Such appliances are invariably cast in sand, and well known examples are: Valves of all descriptions, cocks, injectors, couplings and unions. Copper alloys used for water and gas work are not made from steam metal, for the reason that the conditions are such that a cheaper alloy may be employed. Steam metal is a material intermediate between gun metal and the cheaper so-called composition, and may be said to have been evolved, to a certain extent, by the introduction of automatic high speed machinery.

Valves and similar appliances to be used for the purpose of standing steam pressure must conform to several requirements: They must be strong and yet not brittle; they must be non-corrosive; and, at the present time, circumstances demand that they must be capable of being worked at a high speed. Gun metal, an alloy usually composed of copper, 88 per cent; tin, 10 per cent, and zinc, 2 per cent, while perfectly answering the first two requirements is too refractory to be worked with the customary tools. An addition of lead modifies its working qualities to a certain extent so that the speed of working may be increased, but even when lead is added there is still the objectionable hardness. Again, when too much lead is added brittleness is apt to result. Zinc is added to alloys of this description to give sound casting qualities, but if too much, even of this element, is introduced the result is disadvantageous. Steam metal, then, is but the natural evolution of many years experience with automatic and high-speed machinery. As far as known, no one claims the invention for himself, probably because the alloy is so similar to gun metal in composition, but it may be of interest to state that, for a material cast in sand, steam metal is more largely used than any other definite copper alloy.

But what is the composition of steam metal? Such a question is pertinent at this stage. Before fully answering this inquiry, the results of various experiments made with this very object in view will be given.

Samples of steam goods were obtained from the various leading makers in the

*Erwin S. Sperry, Bridgeport, Conn., in The Aluminum World.

United States and analyses of them were made by the author. Parts of them, as well as test bars made from new metal, were tested on a testing machine. For trade reasons the names of the makers are withheld and their names are designated by numbers. All of them are makers of a regular line of steam goods and represent the largest manufacturers in the business.

Experiment No. 2. 20 lbs. of Lake copper were melted under a good layer of charcoal and then 1.5 lbs. of tin, 1 lb. of zinc, and 1 lb. of lead were introduced. After stirring thoroughly, the mixture was poured into green sand as a bar 5/8 inches in diameter and 18 inches long. It was cast horizontally and a clean bar resulted. It was not turned down.

RESULTS OF ANALYSIS OF VARIOUS SAMPLES OF STEAM METAL.

Maker	1	2	3	4	5	6	7	8	9
Part	Spindle 1 in. Gate. Per Cent.	Body 1 in. Globe. Per Cent.	1 in. Union. Per Cent.	Body 2 in. Globe. Per Cent.	Body ½ in. Gate. Per Cent.	Gauge Cock. Per Cent.	¼ in Angle Valve. Per Cent	Injector. Per Cent.	Spindle 2½ in. Gate. Per Cent.
Copper	88.40	90.50	83.69	86.45	89.23	87.03	90.12	86.32	80.10
Tin	5.70	4.22	2.84	7.15	4.15	5.33	4.10	9.26	4.79
Zinc	4.01	3.41	10.32	4.38	3.75	4.23	2.90	3.05	5.85
Lead	1.89	1.87	3.23	2.04	2.79	3.34	2.76	1.00	8.82
Iron	....	....	.24	....	.08	.07	.07	.08	.07

In order to learn what the strength of steam metal is when made from new material, a few experiments were made. The results are classified and described below. Included in the tests are the results obtained on some of the material, the analysis of which has just been given.

Experiment No. 1. Melted 43.5 lbs. of Lake copper in a plumbago crucible, and then added in the following order: 2.5 lbs. of tin, 2.5 lbs. of zinc and 1.5 lbs. of lead. The copper was melted under a good layer of charcoal, and, after the metals had all been added, the mixture was thoroughly stirred. The alloy was next poured into green sand as a test bar 1 inch in diameter and 24 inches long. The bar was cast horizontally and was left for the purpose of testing without any machining whatever, as it was, on account of the absence of imperfections, found to be unnecessary.

Diameter (average).....1.111 in.
Tensile strength .....30,000 lbs
" " per sq. in.....30,800 lbs
Elongation in 1 in.....25%
" 12 in.....20.4%
Reduction of area.....22%

The center of the fracture was crystalline and yellowish-brown in color. The outside was also crystalline, but finer and radiating. The fracture was free from dross.

The composition of this alloy in parts per hundred is:

Copper 87.00%
Tin 5.00%
Zinc 5.00%
Lead 3.00%

Diameter (average).....0.676 in.
Tensile strength .....9,340 lbs
" " per sq. in.....26,000 lbs
Elongation in 1 in.....19%
" 10 in.....12.4%
Reduction of area.....17%

Fracture crystalline in center like that of experiment No. 1. No flaws in it.

The composition in parts per hundred is:

Copper 85.10%
Tin 6.38%
Zinc 4.26%
Lead 4.26%

The following results are from the parts of the valves whose analysis is given elsewhere:

Maker	1	9
Part	Spindle 1 in. gate.	Spindle 2½ in. gate.
Diameter (turned down)	0.347 in.	0.293 in.
Tensile strength	2,469 lbs.	1,836 lbs.
Tensile strength per sq. in.	26,000 lbs.	27,200 lbs.
Elongation in 1 in.	16%	18%
" 6 in.	.....	15%
Reduction of area	.....	18%

From a perusal of the analysis it is seen that steam metal is an alloy consisting of coper, tin, zinc, and lead. The small amount of iron noticed in some of the results is invariably present in all steam metal as an impurity and not as an intentional ingredient. It is introduced into the alloy from small amounts of iron or steel chips in scrap used. Iron skimmers and stirrers likewise contaminate the metal, and as common zinc contains considerable iron a small quantity is introduced from this metal.

Copper is, of course, the base of the alloy, and is used on account of its non-corrosive properties and strength when alloyed. Pure

copper is too soft and tough to allow its use alone for making castings for steam work although it would answer the purpose admirably as regards corrosion. Again, its casting qualities leave much to be desired. To obviate the difficulty of using a soft and tough metal like copper, which is not only refractory in working but would not hold its shape, tin is added to harden it. While hardness follows the introduction of tin and the alloy becomes stiff enough to hold its shape, the casting qualities are unsatisfactory. Liquation and unsoundness are the difficulties which almost invariably follow in sand castings. Zinc, therefore, is the usual remedy for such troubles. There is yet one thing wanting, however, and that is some addition to give the alloy the necessary working qualities. A metal or alloy to be clean working and capable of being cut at a high speed must make short chips. Lead imparts to the alloy of copper, tin and zinc such a property, and at the same time, provided it is not added in excessive amounts, does not materially effect its stiffness. The introduction of lead into an alloy of the description of steam metal requires much care and consideration. It is doubtful whether any additional benefit results in adding more than two or three per cent. Above this amount the phenomenon of liquation is much more apt to occur and, while such a resulting defect may not be visible to the naked eye, yet weak spots occur in the casting, which, when strained, invariably fracture. The more lead steam metal contains, the more corrosive it is. This assertion may be proved by putting a piece of steam metal which has been thoroughly cleaned from oil and oxide, in pure water. In even a few minutes the water begins to become cloudy from the formation of lead hydroxide, and the action continues without interruption until the water becomes milky.

As previously remarked, iron is invariably present in steam metal in small amounts. A distinction should be made in alloys of all kinds between iron chemically combined and iron mechanically present in the metal. Chemically combined iron has no injurious effect in steam metal if present in quantities even up to one per cent. Its only influence is a slight hardening of the alloy, which in the case of steam metal, were it possible to always chemically combine it, would be a direct advantage. In the case of mechanically combined iron, however, the effect on the alloy is quite different. Iron chips, pieces of tools, and other foreign substances contaminate the scrap which must be invariably used in the manufacture of steam goods and, although the iron or steel may have originally been soft and free cutting, after it has been melted and cast with the alloy it becomes as hard as chilled iron, and when the casting is being worked, ruined tools are the result.

As for the best mixture for steam metal it may be said that a maker soon finds that an alloy may be slightly changed to suit the case. Bodies and hubs of valves require better metal (i. e., stronger and sounder) than some of the internal parts. The spindle of a valve requires strong metal as it is subjected to considerable torsional stress. Some makers use one mixture for the entire valve. Small valves as a rule may be made of a cheaper mixture than large ones.

A good alloy adopted by one of the best makers of valves and other steam goods is as follows:

Copper	85%
Tin	7%
Zinc	5%
Lead	3%

Such an alloy probably represents a standard composition for this class of work.

Some Early Experiences.

BY DROPOUTS.

Did you ever try to melt brass in a common iron pot such as your wife cooks cabbage in? If you have not, the writer will say "don't." If you have tried it I take it for granted that you will not need my advice.

As the writer has explained in a previous article, we began our foundry career under very adverse circumstances, our principal drawback being a shortness of cash. But being blessed with a bulldog perseverance and a determination to succeed, we did not let a little thing like shortness of funds bother us to such an extent as to prevent us from entering the fraternity of foundrymen.

So it came to pass that we circulated the report among our customers that in the future they would be able to procure their castings right at home and save the delay attendant upon sending to the city, about 100 miles distant.

One morning while we were standing in our office door watching the grass grow in

front of the shop, a customer came up with a small gear about 6 in. diameter that he wanted made at once and out of brass. We explained that we must first make a pattern, and as he concluded to stand the necessary delay, we proceeded to make it. This was not a very easy task to begin with, as we knew nothing of patternmaking. We had a very poor school education but had made up for our deficiency by studying at home, and had, with the aid of Joshua Rose's excellent works, about mastered the gear-tooth principles, and our only difficulty was in cutting out the teeth to the lines that we had scribed on our block of wood. After ruining several blocks we finally succeeded in making a pattern that we were proud of until we went to mold it; then we found that it tore up the sand in such a manner as a good pattern would have been ashamed of doing.

Finally, after about ten or twelve hours' work, we had a mold that we thought was all right, and our next care was to melt the brass. This we did not think would be hard to do, as Haswell told us that cast iron melted at 2479 degrees, while brass melted at 1900 degrees, so all we had to do was to put the brass in an ordinary cast iron pot and melt it. Well, we got our iron pot and filling it with brass borings, we placed it on the fire in the blacksmith forge and proceeded to melt it. After awhile we noticed a blue flame issuing from the fire, and an examination proved that our pot had melted. I, being the oldest, had superintended the operation, and like all other good superintendents when things don't go right, I had to give an excuse for the failure. This I did by telling my brother, who was turning the blower, that he blew too hard and melted the pot before the brass got hot. We got another pot and tried it again, blowing easier, but the only difference that we noticed was that it took the pot a little longer to melt. We then decided to get another pot and let me do the blowing, as I still contended that with easy blowing we would be successful. For did not Haswell say that brass melted at a lower degree than iron. Another pot procured and with me on the blower, my brother meanwhile acting as superintendent, we obtained the same results that we had previously.

Now I was compelled to make a new excuse, and I frankly told my brother that it was my opinion that Haswell had made an error and that iron melted at a lower degree than brass.

We then decided that I should go up to the college and consult our friend Prof. McCullah, as we considered him an encyclopedia of useful knowledge. (Some years after I was told by a prominent college president that Prof. McCullah was one of the best informed men in the United States.)

When I told my little tale of woe, ending with my opinion that Haswell was mistaken, the old fellow smiled and gave me a fund of information which clearly proved that Haswell was correct and that I, the product of the twentieth century, while being newer and belonging to perhaps a more enlightened epoch, could not well afford to make myself ridiculous by questioning the statements made in standard reference books.

He went to great length explaining how brass was melted in crucibles and offered to loan me one, but on examination we found that his largest was too small for our purpose, as his was of the small size used in the laboratory of the college, but he told us where we could order one, which we did, after raising enough cash to cover the amount that he thought it would cost.

Finally it came, and full of joy, I built a fire of coke in the forge and built bricks around it as the professor had instructed. After I had a good hot fire I put the crucible full of brass on. In about three minutes there was a report that scared us nearly to death. After we had gathered our scattered wits my brother asked me what caused the report. Of course, I had to offer some explanation, so I told him that I supposed that the crucible must have powder or dynamite in its construction.

About that time the professor came in and said: "Boys, I forgot to tell you the other day that you must heat your crucible very slowly the first time it is used, as they are made of a composition of clay and plumbago that is mixed wet and shaped into the crucible, after which they are dried, but they reabsorb moisture from the atmosphere, and if heated rapidly invariably burst."

I grabbed a pair of tongs and jerked our crucible out of the fire, only to find that a large flake had scaled off from one side of it near the bottom, but it was not too badly hurt to be used; so the professor annealed it for us, after which we had no trouble melting our brass. But our afflictions were not

over, for when we went to pour our mold it spit and spluttered terribly. This the professor said was caused by the mold being rammed too hard, and advised us to go easier on the next one and to experiment with different degrees of ramming until we learned how hard to ram.

We finally made the gear; not without flaws, however. But it took us years to learn how hard to ram, and even to this day we will sometimes find a scab or a swell on our work.

Beleaguered Ambitions.

BY JAMES A. MURPHY.

From Mr. J. G. Fletcher's paper on steel founding read before the Manchester (Eng.) Association of Engineers, and which was published in the February FOUNDRY I cull the following passage with the intention of offering a remedy, at least a partial one: "Steel founders, with all other metal founders, are seriously hampered, however, by the appalling general ignorance (on scientific subjects) of the molder, who after all plays an important part in casting manufacture. It is high time our molders realized their position in this respect and applied themselves to the task of gaining knowledge respecting metallurgy, heat and machine design, such knowledge, by the way, being now so close at hand." There seems to be a lack of harmony between the above paragraph and the sentimental "gush" ladled out to the American molder through various periodicals about the superiority of foreign molders. I have read such stuff many times and though I have no wish to deny any man his just dues I say without hesitation that the American molder has no superior on earth. In saying so I do not wish to be understood as detracting, or trying to detract from the many excellent qualities, mechanical and otherwise, of foreign molders, indeed many of them take their place—and justly so—amongst the best workmen in the country. But (with a big B) did you ever stop to consider how much of these eminent mechanical qualities have been acquired in American practice. Judging from the work done we know that there are some good molders on the other side of the Atlantic, but we also know that just as good work is done here nowadays. There are plenty of bad molders there just as well as here. It is possible to accelerate and stimulate education along the lines laid down in Mr. Fletcher's paper, but only through the hearty co-operation of the employing agency. I should like to hear of the American Foundrymen's Association adopting a resolution that they would not take any boy as an apprentice who had not the common school allotment of knowledge in arithmetic, algebra, geometry and drawing and after they had taken him give him a chance to exercise these branches in his trade and show him where they are useful and indispensable requirements. There is nothing that will take the ambition out of a boy like hard work, not the kind of hard work that the philanthropists tell us about. No indeed, most of those people don't know what hard work is.

Keep a boy or a young man shoveling sand all day, helping a molder, or have him doing some plain work and give him anywhere from six to twelve large ladles of iron to carry every night and after he shakes out his work he is more apt to curse the day that he was ever put in the foundry than he is to go to the library or to night school, or study at his own table. The goad or the whiplash is not more cruel than the more humane method of overwork in thickening the intellectual qualities of man or boy and dimming the mechanical vision. The average employer (there are honorable exceptions) is to-day responsible for the lack of good tradesmen. If the employer sets a standard (the higher the better) the men will try to reach it. A high standard may work some hardships; but infinitely better have it than no standard at all. There are certainly opportunities in some places for gaining an education on metallurgical subjects, notably in the large cities where there are good libraries. But many stop and say, "What do I care for these things. I don't need them, and well, my boss would not appreciate it anyway." It is true that many employers or their foremen look upon such things as jack-a-dandy attainments unsuited to the foundry business, preferring themselves to follow the "good old way" or rule of thumb way of doing business.

I hope to see the day when employes in foundries will be considered more important factors than mere automatons. The brain is gradually gaining headway over brute strength, and a good brain in a healthy atheletic body is a prime factor in determining the future abilities of any mechanic.

Employers should taboo the drink and chronic "loafing" habits, both are conducive to bad work, bad morals and bad discipline in their shops. Learned professors may talk, write and prate for years on the technical education of molders and others, but just as long as the employer takes no interest or requires no standard of ability beyond that of being a good strong sand pounder just so long will there be scientifically ignorant molders, but just let the employers set the example, demand that apprentices attend night school or see that they are holders of cards in the libraries, and you will find that journeymen will take the hint also.

Encourage the inventive faculty. Many foundries are in a very crude condition. The best brains of the country are in the heads of working people. The academician has only a theory, the educated workman has with his theory the benefit of practical experience and upon that experience his theory generally is based. I should like to see, when a new oven is to be built or a new flask to be made, or any "rig" ordinary or otherwise contemplated for the foundry, the molders taken into the firm's confidence in so far as a notice like the following is concerned:

To the Molders.

Gentlemen: We would be glad to have your advice on the building of a large flask for pattern No. — which can be seen at —— or plan of which can be seen at —— Plans and specifications concerning the same will be thankfully received and greatly appreciated by. Yours respectfully.

G. PROGRESS, Supt.

This would encourage the inventive faculties which lay latent in molders and it is not until some of them become foremen that there is a chance for this special development in some while others are content to follow in somebody else's footsteps, parrot-like imitators, or go backwards altogether. Many foremen are very jealous of suggestions preferring to have their own headstrong way and are just as often on the "good enough" road as any other. I remember in one particular instance in a shop where I worked some years ago of seeing a new set of grate bars made for an air furnace; as some improvement was contemplated I suggested to the foreman that it would be a good plan to utilize the principle and style of the common locomotive rocking grate for the purpose, and though apparently paying not much heed to my suggestion it was adopted just the same. Somehow it got among the men that that rocking grate was my idea, though I never boasted of it; but I had the illwill of that foreman until I left the shop, which was not long afterwards.

There is no doubt that there is a movement among the employers and among the molders for better educational facilities for molders. But as far as I can observe it is only yet on paper. The various unions of molders ought to see to it that there are books on foundry subjects placed on the shelves of all libraries in their respective cities and towns.

Molders are no doubt scientifically ignorant and they don't deny it, but remember that the trustees and librarians of our many public book houses are densely ignorant on industrial subjects and more so on foundry matters than any other line of mechanical endeavor.

To illustrate, only a short time ago I visited the public library of the mosquito-ridden New Jersey city in which I am at present domiciled and after looking over their Dewey style catalogue I said you have no books here for molders, and there are about four hundred in the city. Although they had heard of such things as foundries they had never heard of molders. After some talk on the subject the librarian brought the matter before the board of trustees together with a list of books that I was requested to submit, with the result that among some others I was successful in having West and Bolland's books and THE FOUNDRY placed on the shelves. It is to the best interest of any manufacturer to have as many intelligent men as he can get hold of. It redounds to his interest to have the sanitary and ventilating arrangements of his shop as perfect as possible. Ventilation and light are as important to the foundry as education is to the mind. Education developes the brain and mind. The conditions of the shop develop or retard the energy. I say to employers:

Insist upon a certain standard of education in your foreman. The days of the ignorant bully are gone.

Insist on your apprentices having an education suited to the requirements of the foundry.

Encourage and appreciate educational qualification among your men and encourage

the inventive faculty in some manner, if not in the way suggested above.

Try and bring out what is best in your men for your own and their benefit. Do not hamper ambition or trample on ideas. Throw back to European countries that old "saw" that "familiarity breeds contempt." That proverb is only fit for military cads.

I might add in conclusion that every foundry ought to have a number of books on foundry subjects and occasionally loan such books to their apprentices or such journeymen as may want to use them. A casting saved through the information gleaned from them would in a great many cases pay for the books and the trouble in the proposed suggestion.

A little mutual interest displayed in this way on the part of employers and molders for the better education of the craft would do more towards the goal sought than all the elaborate plans spoken of by learned professors and those versed in the higher mathematical engineering. It is the natural ambition of man to acquire learning, to become master of the art in which he is engaged, to gain a higher sphere in life and better his own condition. Ambition and selfishness are the stimulating qualities of human nature and they should be encouraged and fostered in all workmen by those whom they serve.

"Foundryological jurisprudence" does not generally recognize or appreciate at its true value the necessary qualities referred to. Indeed, the very reverse is the case in many instances. The ambitions of many molders seem to be beleagured by some unwritten and invisible law, and derided by the ignorance and prejudices of many of their own fellows and by the still more belligerant and unpardonable ignorance of many foremen and employers.

Foundry Facings.

From an article prepared by Malcom McNaughton, of the Joseph Dixon Crucible Co., Jersey City, N. J., concerning the use of facings and the quality demanded for different kinds of work, we have condensed the following:

Molding is generally divided into four classes, to wit: Plate, green sand, dry sand and loam. This classification indicates not only the methods by which the castings are made, but serves in itself as a guide towards the selection of a suitable facing.

Plate molding is always used for light castings, and while it is within a certain sense of the word green sand molding, we have classified it by itself since it demands a different treatment in the application of facing from ordinary green sand molding.

Owing to the ornamental designs prevailing throughout plate molding, facing cannot be rubbed or brushed upon the surface of the mold without injuring the delicate lines of the design. In order to get a smooth casting the pattern is returned, or printed back, to its original position, after a coat of heavy facing, followed by a coat of charcoal facing, has been evenly distributed over the mold with a blacking bag.

In green sand work a facing may be applied with a camel hair brush, by hand, or dusted on with a bag, and afterwards "slicked" down. It should be noted that since the castings in this class of work are much heavier than those in plate molding, it is necessary to use a more refractory facing.

Dry sand work may be divided into two branches, skin-dried molds, in which only the surface of the mold coming in contact with the iron is dried; and dry sand molds, where the whole mold is dried by being placed in an oven or having fires built within or surrounding it. In each method different sand mixtures are used; in fact, such a variance exists in dry sand molding that but few shops pursue a similar course.

In loam molding patterns are largely done away with, and the material used for forming the mold must be one that is very flexible and readily follows the lines of the sweeps. This is very plainly seen in grooved drums and castings of a like character.

Before proceeding further let us discuss the theory upon which is based the use of foundry facings. The facing is, in the first place, put on the surface of a mold simply for the purpose of preventing adhesion of the metal to the sand of which the mold is composed. But besides the fact that it saves cleaning of the castings, it also gives them a far better appearance, and the surfaces so treated are very much easier to work in the machine shop. Wherever metal burns into the sand it causes hard spots on the castings, which quickly dull the edges of cutting tools. The reasons why graphite or plumbago facings or silver lead prevent

this, is as follows: Carbon is a combustible material, so that when the metal is poured into the mold, there is a sufficient amount of air in the mold itself, and also carried in by the stream of molten metal to bring about a certain amount of combustion. You may have noticed that when a drop of water falls upon a warm stove, it rolls about until it is entirely evaporated. The water itself never comes in contact with the hot surface of the stove, being separated by a film of vapor. The condition which obtains here is precisely that which exists in the mold,—the facing begins to burn and a film of gas forms between the facing and the iron. This effectually prevents any adhesion of the metal to the sand, and just as long as this gas film exists no adhesion can possibly occur.

With regard to the difficulties to be met with in any foundry work, it is understood that a facing must burn in order to be effective, but at the same time if it burns too much, that is, gives off too much gas, we immediately get into difficulty. A proper facing will adhere perfectly to the sides of a mold, and will burn and form gas in a slow and regular manner; that is, burn just enough to furnish this little film of gas referred to above. We want to form the gas, but want to form only the least possible amount of it, and at the same time this gas must be formed during the entire time that the metal is in the fluid condition.

Another point following this is the fact that two bodies cannot occupy the same space at the same time, so that in using a cheap facing which burns fast and gives out a large amount of gas, this gas is liable to become pocketed inside of the mold, and so prevent the iron from filling the mold. This causes what are called "cold shuts" on castings. The ordinary cheap coal facings act in this way. One of the other difficulties in the use of improper facings is that of their running before the molten metal. Poor facings are not sufficiently adhesive to the sand mold surface. The hot iron, coming in contact with them, immediately dries out the sand, and if an inferior facing is in use, it will run and leave the mold surface bare. These two points alone will indicate to you why the Dixon Company make such a variety of facings. The conditions which exist in foundries are so various that it would be quite impossible even to make one facing for green sand work, and another for plate work, and that they all be equally successful in different shops. One foundry uses sand quite wet when compared with the practice in another shop. There is also a great difference in the character of the sands themselves, and there is also a great difference in the method of making the molds. In one shop the practice would be to ram the sand very much harder than in another shop. All these things have their bearing on the successful use of even a good facing.

The Universal Molding Machine.

The attention at the present time bestowed upon molding machines is reflected in the number of machines being placed on the market.

Fig. 1 shows the general appearance of the Universal Molding Machine, while Fig. 2 shows the relative position of the different

FIG. 1

parts after the mold has been rammed, the head turned back and the pattern drawn.

The pattern plate is provided with an arrangement by which the pattern may be instantly adjusted, permitting slight changes in the thickness of the casting to be made

without trouble or the overcoming of minor faults in the original adjustment of the pattern.

The operation of this machine differs from others of a similar type in that the ramming head is brought down upon the mold in ramming instead of the mold being elevated against the ramming head. By this method the workman gains the benefit of the weight of the head, and it consequently requires less power to ram the mold.

The draw plate of this machine is made so that it can be accurately adjusted and an absolute perpendicular movement guaranteed. Any desired length of draw, varying

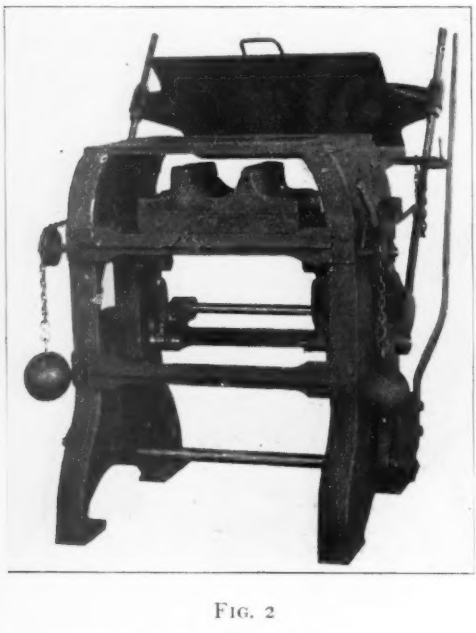


FIG. 2

from one inch to nine inches, can instantly be had. The arm which connects the shaft with the link, raising or lowering the pattern, can, if desired, be increased in length, thus permitting of a deeper pattern being used.

The machine is designed to do a great variety of work, and is Universal in that it permits of squeezing work on a stripping plate or hand-ramming work on a stripping plate, or squeezing work which does not require a stripping plate. Each operation is independent of the others, and in each special advantages are claimed over machines now in use. It will also be noted that there are no mechanical appliances directly under the pattern plate, so that there is room for stooling of any depth.

The Universal Molding Machine Co., of Ansonia, Conn., are the manufacturers.

Many Happy Days.

It had always been thought that Mr. Harry F. Frohman, the pleasant general manager of the S. Obermayer Co., Cincinnati and Chicago, had business enough to attend to keep him forever within the ranks of bachelors, and besides, his many friends everywhere assert that they have tried in every way to make his life a pleasant one. It is therefore with regret and considerable surprise that they learn of Mr. Frohman having become a benedict on April 3rd, his bride being Miss Blanche Seinsheimer, daughter of Mr. and Mrs. A. H. Seinsheimer, of Cincinnati.

W. J. Rainey.

The career of W. J. Rainey, who died recently at Baltimore, in the coke industry was meteoric. He was known as one of the shrewdest of the Connellsville coke operators. It is said that he would never enter into partnership with any person, and he never had a partner all his life. Some years ago, when the H. C. Frick Coke Company was gobbling up everything in the Connellsville region, it is said that this big company offered to buy out Rainey, half in cash and half in bonds. Rainey refused to sell, and asked what the H. C. Frick Coke Company would take in spot cash for its holdings.

William J. Rainey was born in Bellmont county, 66 years ago. He grew to manhood there, and as his father's farm had an excellent strata of coal under it the young man opened this up and began shipments down the Ohio, to Cleveland and other points. In 1877 he turned his attention to the Connellsville coke region. He had had as a confidential clerk and secretary his brother-in-law, Thomas J. Mitchell, at Cleveland, and Mitchell became the manager of his interests in the coke regions.

Rainey first sold Connellsville coke as an agent for two years, and then purchased a piece of coal land at Fort Hill, near Vanderbilt, Fayette county. He erected the plant of 153 ovens there. Next he purchased the Moyer plant on the Southwest railroad and erected 408 ovens there. In 1898 he purchased the Mt. Braddock plant and about

the same time came into possession of the Elm Grove plant and the Rainey coke works near Fort Hill. He came in possession of the Union Coke plant of 70 ovens, near Scottsdale, by closed bids in the Greensburg court, he and the H. C. Frick Coke Company having had some litigation over the possession of the plant.

In 1893 he purchased a big tract of coal land, known as the Wharton tract, near Mount Pleasant, but did not erect coke ovens there until last year. Then he completed 126 ovens, calling the plant Acme. In 1892 he purchased the Hare farm, at Vanderbilt, and there erected the big Paul plant of 500 ovens, and when he left for Europe to regain health at Carlsbad last year he left orders to his manager to make every effort to get the whole of the Revere tract, near Uniontown, but succeeded in getting only half of the 2,500 acres, the other half going to the National Steel Company.

Just what his estate in the Connellsville region is worth is difficult to estimate, but it is well up in the millions. He owned outright and solely 2,231 ovens, of which 2,151 are active. The weekly production of his plants is about 25,000 tons.

Rainey was a man of quick decision. In times of strikes he adopted heroic measures sometimes to uphold his rights. During the last strike in 1894 at the Moyer plant he stationed two Gatling guns on an eminence commanding the Moyer coke yards, and by this means and uder the protection of these formidable instruments he worked his men in peace for many months.—Pittsburg Dispatch.

Among the Foundries.

A new foundry is being started at Monroeville, Ind.

The Kewanee (Ill) Boiler Co. will build a foundry.

H. C. Clark succeeds Clark & Spencer, of Lee, Mass.

Hershey & Hoch have started a foundry at Manheim, Pa.

The Sheridan Stove Co. has been organized at Quincy, Ill.

G. W. Wheland is enlarging his foundry at Chattanooga, Tenn.

Thos. Bailey & Co., of Athens, Ga., will enlarge their foundry.

The Pine Bluff Iron Works has been incorporated at Pine Bluff, Ark.

F. F. Davidson has purchased the Hawkeye foundry at Tama, Iowa.

J. T. Carmody will erect a new foundry, 60x130, at Cedar Rapids, Iowa.

W. A. Lotspeich is said to be intending to start a foundry at Mohawk, Tenn.

John P. Rich has been appointed receiver for the St. Albans (Vt.) Foundry Co.

The New Albany (Ind.) Mfg. Co. is building a new foundry and machine shop.

The Central Foundry Company will enlarge their plant at South Pittsburg, Tenn.

The Guilderland Foundry Co. is a new concern recently organized at Guilderland, N. Y.

The Craig Foundry Co. has been incorporated at Detroit, Mich., with a capital of $28,000.

The Woolley Foundry & Mach. Works will double the capacity of its plant at Anderson, Ind.

W. R. Harrison & Co., of Massillon, Ohio, will erect a foundry to supply their own castings.

The Beverly (Mass.) Machine & Engine Co. has been incorporated with a capital of $200,000.

Geo. C. Crane has purchased a half interest in the foundry of Theodore Kupfer, Madison, Wis.

The Orangeville Foundry & Mfg. Co. has been incorporated to do business at Orangeville, Utah.

The Canada Foundry Co., of Toronto, Ont., succeeds to the business of the St. Lawrence Foundry Co.

George Bauer has been appointed receiver for the Pennsylvania Foundry & Mach. Co., at Akron, Ohio.

It is reported that Hunt, Helm, Ferris & Co., of Harvard, Ill., will erect a foundry in the near future.

The Siemens Halske Electrical Co., of Chicago, has passed into the control of the General Electric Co.

J. R. Coats has opened a foundry at Visalia, Calif., in addition to the one operated by him at Tulare, Calif.

J. F. Chuse & Co., of Mattoon, Ill., have been incorporated under the name of the Chuse Engine & Mfg. Co.

The Craig Shipbuilding Co., of Toledo, Ohio, are erecting a foundry to supply their own works with castings.

The Defrees Gas Engine Co., of Indianapolis, Ind., are reported as intending to operate a foundry for their own use.

S. O. Bishop and Henry Hornby will start in business at Brodhead, Wis., under the

name of the Brodhead Foundry & Mach Mfg. Co.

Plans have been prepared for the enlargement of the Fischer Foundry & Machine Co.'s plant at Pittsburg, Pa., which will double its capacity.

The Wing & Sayle Foundry & Machine Co. has been organized at Little Rock, Ark., by D. R. Wing, C. M. Wing, C. M. Sayle and D. H. Cantrell.

The Reserve Foundry Co. has been incorporated at Cleveland, Ohio, with a capital of $50,000 by J. B. Buhl, D. M. Bader, J. P. Matherson, S. A. Schwab, and J. H. Schneider.

The Logansport (Ind.) Foundry Co. has been incorporated with a capital of $40,000. Directors: Matthew F. Gartland, Frank W. Wilkinson, James F. Dugan and John H. Schaumleffel.

The Barstow Stove Co., of Providence, R. I., has purchased the patterns and stock of the Spicer Stove Co., at that place, and the business of both companies will hereafter be conducted under one management.

The Lehigh Foundry Co. has been incorporated at Fullerton, Pa., with a capital of $50,000 by W. Wood, of Allentown; C. H. Zehnder, W. D. Zehnder, E. M. Zehnder, all of Scranton; H. J. Davis, of New York.

The Utica Heater Co., of Utica, N. Y., lately organized by John B. Jones, E. A. Pinkney, William H. Cloher, Jr., George W. Jones, William Helmke, William T. Smith, of Utica, and William H. Switzer, of Little Falls, N. Y., have absorbed the furnace business of the Superior Foundry Co., at Little Falls, N. Y., and will for the present conduct its manufacturing at that point.

The firm of McLanahan & Stone at Hollidaysburg, Pa., manufacturers of ore and phosphate washing machinery, crushers, conveyers, etc., has been incorporated as the McLanahan Stone Machine Co. with the following officers: J. King McLanahan, president; William Stone, vice-president; H. M. Henshey, treasurer; S. C. McLanahan, secretary; Wm. F. Kirk, superintendent.

The Berlin Iron Bridge Company, of East Berlin, Conn., have increased their capital stock to $750,000, and have made extensive purchases of land at Pittsburg, Pennsylvania, where they will start a branch. They have already placed the orders for the greater portion of their machinery equipment, and are now at work on the plans for their buildings, which will be quite extensive, designed and built by themselves at their own shops. It is intended that this plant shall be fully equipped with all modern appliances for doing all classes of steel bridges and structural work.

The American Machine & Foundry Company has leased the plant of Hanover Foundry & Machine Company, of Hanover, Pa., and, after thoroughly re-equipping it will manufacture all the tobacco machinery used by the American Tobacco Company. Ample capital is at its command and no pains will be spared to make the shop a complete one. A general machine and foundry business will also be done. The officers are Mr. R. L. Patterson, of the American Tobacco Company, New York, president; Mr. Hanson Robinson, vice-president and general manager; J. T. Wilcox, secretary, and Thomas M. Brown, treasurer. Both Mr. Robinson and Mr. Brown were for a number of years with the Detrick & Harvey Machine Company, of Baltimore; Mr. Robinson in the designing and mechanical line, and Mr. Brown in selling and office work.

Personal.

Louis N. Perrault, for the past seven years foreman for the Poughkeepsie (N. Y.) Foundry & Machine Co., has taken a like position with the Jenckes Mach. Co., Sherbrooke, Quebec.

Geo. A. Barden, formerly superintendent of the works of the Standard Pneumatic Tool Co., has been appointed eastern representative of the same company, with headquarters at 141 Broadway, New York.

Fires.

The Union foundry at Rockaway, N. J., burned lately.

Wren & Co.'s foundry at Forst, Ont., was destroyed with a loss of $25,000.

The Central Electric & Foundry Co.'s plant at Lewisburg, Pa., went up in smoke April 6.

The Milwaukee (Wis.) Harvester Co.'s foundry suffered some damage in a recent fire.

The foundry of the Maud S. Windmill Co., at Lansing, Mich., was destroyed a few weeks ago.

The works of the Hoffman Hinge & Foundry Co., Cleveland, Ohio, were gutted in a recent fire.

A recent fire did considerable damage to the plant of Isaac G. Johnson & Co., Spuyten Duyvil, N. Y.

Post & McCords, foundry at Greenpoint (Brooklyn), N. Y., burned April 9, entailing a loss of $50,000.

The foundry of the Virginia Iron, Coal & Coke Co., at Embreville, Tenn., burned, together with adjacent machine shops. Loss $60,000.

Deaths.

Henry Burnham, formerly a well known foundryman of Brattleboro, Vt., died recently.

Geo. E. Webber, one of Ohio's pioneer foundrymen died at Medina, Ohio, recently, aged 76.

James Graham, head of the firm of James Graham & Co., brass founders at New Haven, Conn., is dead.

James L. O'Connor, who for a number of years operated a foundry at New Orleans, La., died there recently, aged 41.

Charles Roger Brown, manager of the railway department of the Michigan Malleable Iron Co., Detroit, Mich., died recently.

Joseph Davenport Warren, president of the Stamford Foundry Co., Stamford, Conn., died April 2, aged 91. Mr. Warren has been identified with the foundry business for nearly 60 years, and was one of the few remaining pioneers of the trade in New England.

Andrew Bolter, one of Chicago's pioneer foundrymen, died recently in that city, aged 80. In 1855 he established the business now carried on under the name of A Bolter's Sons, from which he retired a few years ago. Mr. Bolter was born in Germany and one of the most noted entomologists in America.

Geo. B. Sennett, president of the company which bears his name, died at Youngstown, O., recently. Mr. Sennett was born in Sinclairville, N. Y., July 28, 1840, and about 35 years ago started in business at Meadville, Pa., at that time building oil well machinery. He removed his plant to Youngstown a few years ago.

Rufus Hart, of the firm of Osgood & Hart, Charlestown (Boston), Mass., died recently of heart disease. Mr. Hart was born in Kingswood, England, about 63 years ago, and came to this country at an early age. He entered the Lowell Machine shops and there met Mr. Osgood with whom he has been associated for the past 27 years.

Addison C. Rand, president of the Rand Drill Company, died at his home in New York, in his sixtieth year. While Mr. Rand had not been in robust health for several years, no apprehensions were felt by himself or his friends. His last sickness was but little over a day in duration, and hopes of his recovery were entertained by his physician almost to the last. His remains were taken for burial to the home of his boyhood—Westfield, Mass.

Carbide of Silicon in Cupola Practice—A New Softener.

BY F. J. TONE.

This unique electrical product of "hottest heat" has come to occupy a very diversified field in the manufacturing and metallurgical world. Its original and chief use is as an abrasive, a purpose for which it is pre-eminently adapted by reason of its extreme hardness. Later its intense refractory qualities became recognized, and it gives promise of becoming a valuable material in the manufacture of fire brick, refractory linings and crucibles. In the manufacture of steel its chemical composition early brought it to the attention of metallurgists as a ready source of silicon and carbon, and it is now in special favor with the manufacturers of steel castings, among whom the consumption is very large.

The same properties which make it valuable to the steel maker, make it even more valuable to the founder, and certain difficulties which were at the outset encountered in getting it into solution, have now been overcome, making the method of use very simple.

Carbide of silicon is produced in an electrical furnace from coke and sand, and contains theoretically one atom each of silicon and carbon, making the proportion by weight, silicon 70 per cent and carbon 30 per cent. As manufactured by The Carborundum Company, at Niagara Falls, the commercial article contains certain impurities. An average analysis is as follows:

Silicon	62 per cent.
Carbon	35 per cent.
Iron	1.5 per cent.
Aluminum	1.5 per cent.
	100 per cent.

Calcium and magnesium are also present in minute traces. The iron and aluminum are not present in the metallic form, but like the silicon in combination with the carbon as carbides. It is absolutely free from injurious impurities such as phosphorus and sulphur, these elements being volatilized and

expelled from the furnace at a temperature far below that at which the formation of carbide of silicon begins.

The action of silicon in cast iron has been the subject of exhaustive study and investigation. Opinion is not wholly unanimous among authorities as to what extent it is the governing factor in determining the final quality of a casting; but it is well established that an increase of silicon will change combined carbon into the graphitic form, and thus give an increased softness very desirable in machine work. This action is probably most pronounced with the higher temperatures of the blast furnace, and does not always occur in marked degree at the lower temperatures at which the cupola is operated. Silicon, then, is a softener and lessener of shrinkage only by reason of its influence on carbon. These two elements together are the governing factors and their occurrence in carbide of silicon in such large proportions, constituting as they do the entire product, make it an ideal material for supplying any deficiencies which may exist in the original iron.

One of the greatest difficulties with which the founder who uses any scrap must contend is dirty castings. The cause of this is most often traced to the iron oxides which may exist in the scrap in the form of rust or burnt iron, or may be formed from prolonged heating in the cupola. Silicon is a very active de oxidizing and reducing agent, and when used with irons of the above character, it has the power of reducing a portion of these oxides to metallic iron and silica. At the same time, it unites with a certain portion to form a fluid slag of iron silicates, preventing their appearance in the casting in the form of dissolved iron oxide, dirt and spongy metal.

Carbide of silicon has been found to be especially adapted for this purpose, making available iron carrying a large burden of dirty or burnt scrap. Many founders are so situated as to transportation facilities that the use of scrap drawn from neighboring sources in place of pig transported great distances, becomes a matter of great economy, if not imperative necessity. As a fluxing material and softener for this class of founders, carbide of silicon is most valuable. It has been found possible to melt a charge composed entirely of burnt or small, rusty scrap, and by the judicious use of the carbide, obtain a clean flowing metal and a sharp solid casting. Without the carbide, there appeared to be more slag and dirt than iron, and it was wholly impossible to handle it.

In this case the carbide acts mainly as a reducing and fluxing agent. The metallic iron produced by the reduction of the oxides resulted in a direct gain, as was evidenced by the small amount of slag, and the fluxing action was very marked from the fluidity of the slag and the manner in which it remained free from the metal. In practice it is found that an amount of the carbide as low as one per cent of the weight of the iron in the charge will have a marked influence on the quality of the castings and behavior of the metal. This follows from its high silicon content, a very important advantage in convenience of handling and many other ways, when we consider that ferro-silicon carries only 10 to 14 per cent silicon and Scotch iron as low as 6 to 8 per cent.

The method of handling carbide of silicon in the cupola is very simple. The steel founder adds the powdered carbide in the ladle as he is tapping the furnace. The heat is very intense and the carbide becomes well intermixed under the stream of molten metal, being completely dissolved by the time the ladle is filled. This method was at first pursued in cupola practice, in fact being still used to a very limited extent where the temperature is high. With the lower temperatures generally employed, however, which is four or five hundred degrees below that of melted steel, it is found that solution proceeds very slowly. The method most successfully employed is to charge the carbide of silicon in lump or brick form along with the pig and coke, placing the proper amount on top of each coke charge, so that as the iron melts it will come in contact with and flow over the carbide, completely absorbing the same. It has a marked effect on the fusibility of iron and fluidity of the metal in the ladle, following in this regard the well known action of all high silicon irons, tending to make them take delicate molds well and produce clean, sharp castings.

It thus becomes apparent that carbide of silicon has a wide application in cupola practice, and with decreased cost of production it is bound to become a familiar material in every foundry.

There are some foundrymen who never saw a ladle of hot iron and don't know what it is.

The Necessity of Modern Tools in a Foundry.

BY J. B. RAMP.

It is traditional that all one needs to start a foundry is a few wooden flasks an old worn-out boiler for a cupola, a horse-power machine or an old played-out engine which somebody threw into the scrap heap; get a cheap, second-handed blower, a few loads of clay, called molding sand (by some one who knows nothing about it), an old-fashioned wood stove for a core oven, a load of scrap iron and coke which is bought of the gas manufacturers, because it is cheaper than Connellsville, and you have a full-fledged foundry ready for business. If you are not able to make castings and compete with your neighbors, who are in the same business, you come to the conclusion you have a poor lot of molders, and that they are not doing enough work.

You commence to drive them beyond their abilities; they soon begin to drop out, and you take in anybody who comes along and says he can pound sand, and what is the result: you soon realize you are worse off than you were before.

Now, after many years of experience, the fact still impresses me, that if proprietors of foundries and machine shops would put more time and money in the foundry instead of turning all their attention to the machine shop, the former would be a successful investment. The machinist will tell you, I cannot fit up that five-ton casting without a suitable planer or boring mill, which may cost thousands of dollars, and the tools are promptly furnished.

But what are the conditions in the foundry? The patternmaker does his part of the job, and tells the foreman of the foundry how he should make it. The foreman then looks over his flask-yard for something to make it in, and soon finds he has no tools to make such a job. He tells the proprietor he must have a flask made; the answer is, it costs too much, you must fix up something. He picks out the best he has and makes a cheap fixture. The molders consume twice the amount of time on the job trying to make it safe. They cast it, and some weak spot gives out, causing the loss of the casting. The men are dissatisfied, their employer is disappointed, to say nothing of the loss financially. The material and labor are all gone, and when you count the rebreaking of the casting, the handling and getting it through the cupola again, the loss to the proprietor is complete.

There are some well equipped foundries to-day, but eight out of ten of them started as stated above. To illustrate: I had a proprietor of a large machine shop and foundry tell me that a foundry was a necessary evil, and he had the poorest equipped foundry I ever saw for turning out the class of work that he was doing. To run a foundry successfully you want an intelligent man to take charge of it, a man that knows his business. There is a certain amount of work the molding machine will do, but it is limited. A first-class molder is a thinking machine, and if he has tools to work with he will be a profit to his employer.

You will naturally say—what tools do you want to start a foundry with? I want a quick melting cupola of modern make. You do not hire molders to sit around the shop and wait for iron. A first-class power crane and an oven equipped with cars, making it suitable either for molds or cores, are essentials. The blower is an important factor, for you cannot melt fast without a first-class blower. And equip your shop with a trolley system where the crane will not reach.

In conclusion, let me say that the molder, properly equipped, is the only producer in a foundry, and every man brought in to assist in the work becomes a consumer.

A Chance to Theorize.

BY ELI H. PEARCE.

P. Duncan & Co., in the March FOUNDRY want to know if there is any benefit derived from having a long blast pipe. Most emphatically I would say No, as I have found by actual experience that the shorter the pipe the better the result obtained; the only function of a blast pipe is to supply air to the cupola in order to promote combustion, and not to gather 'lectricity as the expert claimed. (Durn such an expert.)

The writer has had considerable experience with cupolas, has had them cut up all sorts of capers that were not very amusing at the time, but after successfully overcoming the trouble we were generally inclined to feel amused at our ignorance.

We once had a little cupola 18 inches in diameter, after daubing, for which we had bought a fan blower of a reliable make and adjusted it to the speed given in the manufacturer's catalogue, but there was one thing that we overlooked, or to be candid, that we were ignorant of. This was that air passing through pipes loses a great deal of its volume through friction. We had the blower placed about 100 feet from the cupola and used the same size pipe as the outlet of the blower demanded. We melted iron and had no trouble considering our limited experience; our business grew very rapidly, and we put up a 28-inch cupola and bought another fan, which we arranged as the other one, 100 feet from the cupola, and obtained fair results. Our business increasing, again we were compelled to move to new quarters, when we erected our cupolas and lined them precisely the same as they were before moving, but instead of placing the blowers 100 feet away we brought them up to within about 10 feet of the cupolas. We did not change the speed of the blowers nor did we change our manner of charging. Nevertheless, there was a vast change in the melting of the cupolas, for with the 18-inch one we found that instead of melting 800 pounds per hour we could melt 1,100 pounds with the blower close to the cupola. Our 28-inch had melted 2,000 pounds per hour, and with the new arrangement its capacity increased to nearly 3,000 pounds per hour.

Since then our business has again increased, and we put up a 35-inch cupola, and not desiring to buy another fan, we concluded to first try our old fan in order to see if we could use it on the 35-inch cupola. In improving our plant we had moved the cupolas about 40 feet from the blowers, and having read a great deal on the subject of blast pipes and cupolas, we decided that we would increase the diameter of blast pipe to overcome friction. Our blower is a No. 5 Buffalo (I think that is the number); at any rate, its outlet is 7 inches in diameter, and we use a 10-inch pipe to supply the blast to our 35-inch cupola. We can melt a little over 4,000 pounds per hour in this furnace, and when the iron is broken small we can melt about 4,500 pounds per hour, but we seldom do so, as we make it a point to melt our heaviest scrap when the large cupola is at work and save the small iron for the smaller cupolas.

The foregoing is my personal experience, but wishing to back my statements up with the experience of others, I have looked the matter up in some of my different books, and find that Thos. D. West says on page 317 of his Molder's Text Book that the closer to the cupola the blower is placed the better the results obtained. He claims, and I agree with him, although I never made a test to determine it, that it will require more power to run the blower if the pipes are long, owing to undue friction. He says further that when long pipes are used that they should be of an enlarged diameter in order to diminish the friction.

I could not find my authority on the statement, although I searched for it, but I think it was Simpson Bolland who says that the diameter of blast pipes should be large enough not to necessitate the air moving more than 60 feet per minute to supply the desired volume to the cupola, as any greater speed created undue friction.

I have not their catalogues at hand, but either Baker or Root's tells us that when the blast pipe is longer than 50 feet it should be increased one inch for every additional 50 feet to overcome friction.

Edward Kirk, on page 281 of his Cupola Furnace, says: "As air moves through pipes a portion of its force is retarded by the friction of its particles along the sides of the pipe and the loss of pressure from this source increases directly as the length of the pipe and the square of the velocity of the moving air."

On page 289 of the same work we find an illustration of a neat way to arrange a blower close to the cupola, and the writer in describing the arrangement tells us that long blast pipes often cause poor melting, and that the blower should be placed as near the cupola as possible.

Considering all of the above, I would not, if I were Duncan & Co., ask the city authorities for permission to run my blast pipes around the town a time or two before entering the cupola.

If they are really in trouble, I think that if they would give the size of cupola, the size and number of tuyeres, the size of blower and diameter of blast pipe and length (although they claim it is short), the speed of blower or pressure of blast if they have a gauge, the length of the tuyeres, how high

above their tuyeres they make the bed, whether they use coal or coke and if the latter whether it is gas-house or foundry coke, how many pounds of iron they put on the bed and how they continue to charge the balance of the heat, that same reader of THE FOUNDRY could probably help them.

Reserve Capacity of Iron.

"The subject of reserve capacity for the manufacture of iron and steel is one that has received a good deal of attention since the beginning of the iron and steel boom of 1899," says the Bulletin of the Iron and Steel Association. "Superficial observers and sensational writers for the daily press persistently asserted that our capacity for the production of iron ore, coke, pig iron and many forms of finished iron and steel was wholly unequal to the demand that was certain to be developed during the year. To the persistency with which this famine cry was repeated for at least six months of 1899 may be traced much of the excitement that has prevailed in our iron and steel markets, the haste to place orders for future delivery never before having been equaled. And yet, with few exceptions, there was no scarcity of iron and steel or of raw materials all through the year, and much of the scarcity that here and there was developed was due to the failure of the railroad companies to supply cars and motive power for the transportation of raw materials. The same kind of delay has happened in other years. There was no serious scarcity of coke at the ovens and none at all of iron ore at the ports on the lower lakes. The production of coke and iron ore was enormous, and was far ahead of the figures conceded by the alarmists. And so also of the pig iron. We made almost 2,000,000 tons more pig iron in 1899 than in 1898, but the panic-makers said that we had not the reserve capacity to accomplish this result even approximately. The Bulletin, at an early date in 1899, and frequently afterward, printed the figures to show that we possessed this capacity, and that we would make all the pig iron that would be needed. Not only was the extraordinary home demand supplied, but large quantities were sent abroad. We risk nothing in now saying that we will make all the pig iron that we will need in 1900; we will mine and import all the iron ore that we will need, and we will make all the coke that we will need."

Shrinkage of Malleable Iron Castings.*

BY H. O. EVANS.

In the paper by Mr. Davis on "Annealing Malleable Cast Iron," read before this association at its March meeting, the subject of allowance for pattern shrinkage was alluded to.

In a critique of the above paper, written by Dr. Moldenke and read before the Pittsburg Foundrymen's Association as a discussion of Mr. Davis' paper, the author says:

"The expansion taking place during anneal is well known, and allowed for in making the patterns. It may be taken as a general rule that the contraction of the chilling irons used for "malleables" is ¼ inch to the foot. In the anneal an expansion of ⅛ inch to the foot takes place, the net result being the ordinary contraction allowed for gray iron. Patterns are therefore made in the usual manner. The special art of the "malleable pattern" maker being shown in the gating, and chill arrangements, etc." Now as the writer was, at the time Mr. Davis' experiments were made, superintendent of that foundry, he may be pardoned if he uses some of Mr. Davis' figures to controvert the "net result" arrived at by Dr. Moldenke as a guide for the "malleable" pattern maker. The writer's opinion has been since he first encountered the problem in '86, that the "pattern shrinkage" on malleable castings is the greatest variable known since x, y and z were first used to denote such a quantity, and in this we are glad to have Dr. Moldenke's support, as where he states "contraction and expansion are not regular," and "long malleable castings can therefore show some unexpected features." The reason for this he ascribes to the following three causes:

1. Changes in chemical composition of the iron.
2. Casting temperature.
3. Shrinkage in interior.

To these the writer would add a fourth: Annealing temperature and length of anneal. On examining these causes we find that all of them are practically beyond the control of the pattern maker, who is carefully held to drawing dimension with rule and caliper.

In dealing with this question we will do well to divide it into the two natural stages as they occur.

*Paper read at the April meeting of the Foundrymen's Association.

1. The shrinkage, or, more properly, contraction, due to cooling in the white iron casting.

2. The expansion, the result of annealing.

The composition of the iron we will leave to the chemist. The temperature of casting and chilling arrangements to the foundry foreman.

Of contraction in the first stage the commonly accepted rule is ¼ inch to the foot, and this result is borne out by table No. 3 in Mr. Davis' paper, from which I quote:

Size. Bar.	Pat. Length.	White Iron Length.	An'led Length.	Contraction.	Expansion	Net c'n't'n
⅛x1	12.000	11.768	11.832	.232	.064	.168
¼x1	12.000	11.784	11.930	.216	.146	.070
⅜x1	12.000	11.757	11.927	.243	.170	.073
½x1	12.125	11.909	12.093	.216	.184	.032
⅝x1	12.000	11.742	11.942	.258	.200	.058
¾x1	12.000	11.769	11.964	.231	.195	.036
Average				.232	.156	.076

In this experiment the patterns were accurately made on a board, four to each set, were drawn without rapping, and poured from one ladle, with the exception of the ½-inch bars, which were our regular test, and poured as usual, being given three days' annealing at a moderate heat. The iron analyzed silicon 0.60, sulphur, 0.047, total carbon 3.23.

Referring to results, we see that the average contraction, result of 24 measurements is within .018 of assumed contraction, which is very close, and here would call attention to the fact that the maximum variation from average is only .026, the extremes differing only .042, showing that for all thicknesses the contraction is very uniform, at least, when, as in this experiment, the fractures show complete combination.

In the second stage of expansion we note an average expansion of .156, a result which is nearly 25 per cent greater than allowed by Dr. Moldenke, and we also note that the maximum variation is .092 with a difference between extremes of .136 more than ⅛-inch, a not unusual result, and indicating that the source of greatest variation is to be found, as a result of the annealing. "That a remarkable change" does take place during annealing I agree with Dr. Moldenke, but I differ from him when he says "that removal of carbon in the skin is but a small matter," for the fact that we can largely remove it from light sections, confirms the view; that it is to that element we must look for a cause for the expansion that occurs during annealing.

For purposes of comparison we will arbitrarily divide the figures of table into divisions, those of ⅜-inch thickness and below, and those above, 3-16 inch, being the greatest depth from which carbon is largely removed, and I quote the author's experiment to prove this where he planed the ⅝-inch bar, with broken ends, off by sixteenths with following results:

Total C. hard iron 4.08; after annealing first sixteenth contained 0.16, C. second, 0.65; third, 1.84; fourth, 3.97; fifth, 4.05. You will note that at a depth above 3-16ths the carbon extracted is very little, and shows some basis for the old rule that ⅜-inch was the thickest you could get good malleable.

Tabulating under this classification, we note:

First Class (Carbon extracted)		Net Contraction.
⅛ bars expansion	.064	.168
¼ bars expansion	.146	.070
⅜ bars expansion	.170	.073
	.380=av.	.126 .311=av. .103

Second Class (Carbon present).		Net Contraction.
½ bars expansion	.184	.032
⅝ bars expansion	.200	.058
¾ bars expansion	.195	.036
	.579=av.	.193 .126=av. .042

The average in first class is .126 and in the second .193, or 50 per cent more than the lighter section, and the only assignable reason the writer can submit is that the carbon present as graphitic or temper carbon must cause castings to assume larger dimensions in the molecular rearrangement which occurs during the anneal, but from whatever cause the experiments show and the result is in consonance with writer's experience, that contraction to be allowed for is largely dependent upon thickness of section.

It is obvious that with so many causes for variation, no hard or fast rule can be made to apply, but the following rules are what the writer recommends for general use: For light sections, ⅛ inch to 1-16 inch per foot; for heavy sections, above ⅜ inch—1-16 inch to 1-32 inch per foot; for cored holes, have print exact size up to say 2 inches diameter, above use same rule as for rest of pattern.

For a pattern of heavy section that is rapped for drawing make exact size. The writer has followed this rule on castings 2 feet in length with excellent results. The only positive rule to be given is try every pattern before going ahead. In conclusion, would say that in a business that calls for close attention I know no department which

requires a longer experience in malleable casting than the pattern maker's and that "the special art" of the malleable pattern maker is shown in other ways, besides the gating and chilling arrangements.

That results will differ in every shop is evinced by remark a mechanical engineer, in charge of drawing room and pattern shop of a railway which is a large consumer of malleable, made to writer when asked what shrinkage he allowed, he said: "It is almost impossible to figure shrinkage. We send the same patterns to different shops and get a different casting from every one." Whether there be purpose in this madness I wot not.

Admitting the difference, we leave it an open question as to why. Trusting that time and experience may reconcile all differences.

Other Ways of Working.

BY L. C. JEWETT.

There are various methods in different foundries and localities to mold the same casting. The attached illustrations show one way of molding a cone pulley. Fig. 1 is the pattern arranged with a core-print having a very liberal taper, the object of which is to guide the core as near as possible towards occupying the place it should.

Fig. 2 is a sectional view of the mold made from the pattern Fig. 1, and shows the cores in position. In some western foundries, where they have a habit of molding these castings in green sand altogether, I have seen considerable concern manifested whenever a large cone pulley was to be made. Every care was taken by the molder to secure the green sand core

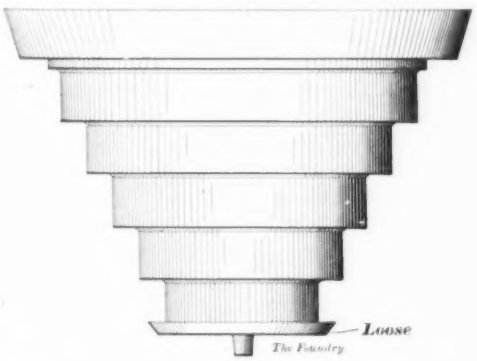


FIG. 1

of the inside of the casting. Nice, even ramming had to be performed to keep the casting from having swelled spots on its interior, which would call for considerable work in balancing it.

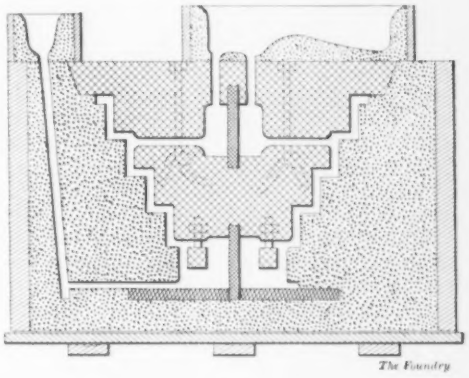


FIG. 2

Taking it altogether, the molding of this kind of castings in green sand exclusively leaves the final result very much of an uncertainty. The job of balancing a pulley can be lengthened or shortened according to the way the molder does his work.

Some thirty years ago Worcester, Mass., was a large manufacturing center for makers of machinists' tools, lathes, drills and planers, and that city is still prominent in these lines. The illustrations previously referred to show the manner in which cone pulleys from 14 inches diameter and upwards were made in Worcester foundries thirty years ago. The sketch will explain itself to most any one having the least acquaintance with tool machinery founding.

Cone pulley patterns made and molded after this fashion have many advantages over the system where a self-contained pattern is employed.

The inner part being dry sand, skill or care on the part of the molder is not required to the extent where green sand is used exclusively. To ram up the outer portion of the block pattern calls simply for uniformity and sufficient firmness to resist strains.

Where arms are required in the pulley the cores are made in sections and bolted together, as shown in Fig. 2, when the hub core is also placed in position. When the core is properly secured at the print, so as to carry the weight of the core, and when the latter is dried slowly, to lessen or prevent swelling or cracking, all the molder has got to do is to place it in the mold, the tapered print bringing it to its true centre.

In this method of molding no cope is required. Place a couple of bars across the top of the core, and clamp the mold securely together, when a few wedges placed between binder bars and core will hold the latter securely.

Two ways of gating a cone pulley are shown. When the casting is not too heavy, it is the best practice to pour from the bottom. Where two ladles are required, or where the pulley weighs from four to eight hundred pounds it is a safe practice to pour a portion of the metal from the bottom and the remainder from the top.

Where many of these castings are made special nowel flasks having a slight taper to conform to the shape of the casting could be used to advantage, as they would not only save some sand but also considerable ramming.

In conclusion, patterns made in this manner are less liable to break or crack, and while there are more parts to take care of still the general economy ensuing would apparently seem to compensate for this and the practice here outlined will appeal to both the patternmaker and the founder.

Southern Foundries.

It seemed to most of the southern delegates in attendance upon the Indianapolis convention that our fellow delegates from the north were not fully alive to the important developments that had taken place in the iron and, especially, foundry industries of the south, and in the hope that we might in a measure remedy this failing by calling attention to the southern progress through the Journal, I have determined to open a series of "notes" devoted to these interests and perhaps to offer suggestions upon which the fullest criticism is invited.

Although foundries have been in existence in the South for half a century or more, they were originally confined to coast or river cities where the repairs required for vessels made them necessary, the real beginning of the Southern iron industry only dates back some twelve or fifteen years. At that time surplus northern capital, finding no opportunity for profitable investment at home, turned to southern fields and it was not long before these shrewd men of business saw in the mineral deposits, coal fields and rich natural resources of the "New South" a profitable field for investment. Mistakes, of course, were made and many investors came to grief, but progress was made. The happy contiguity of large deposits of coal and iron ore in Northern Alabama induced the erection of blast furnaces whose success is briefly told, when we say that to-day they number close upon 100 and that in nearly every city of the United States southern iron is carried from the cupolas by our members—thousands of tons of it.

These furnaces and the rolling mills which were soon established created a big demand for castings which at first had to be shipped perhaps 1,000 miles from northern cities but are now made right at home.

Iron was not the only source of development. The South produces raw cotton for the mills of the world and sugar cane. Why not manufacture on the ground? The answer to the query is given in the erection of numerous cotton and sugar mills. These also created a demand for castings on quick delivery and the southern foundries have been responsive, and scarcely a week passes without news of the erection of a new machine shop or foundry in one of our southern cities. While on the other hand, so many inducements are held out in these hitherto unnoticed fields that the large northern plants, awakened to a sense of danger from their southern rivals are either moving their plants here or establishing supplementary plants.

Of all the world's producing pig iron centers, Birmingham, Ala., stands without a peer and to-day, I believe, turns out a greater tonnage than any other section of the same size on the globe. Within the last twelve months pig iron has advanced from $7.50 to $19 per ton and the output during the same period has increased nearly 60 per cent and is sold well in advance. Southern iron has become popular, and where but a short time ago its stock would be sought for in vain in the list of the New York stock exchange, its quotations are now eagerly scanned by Wall street.

Many readers may wonder why the South can produce iron cheaper than any other section. The most important factors to this end are: Close attention to business, use of the latest improved machinery for handling ore, coal and coke, superior natural resources and cheap labor. The ore used is mostly surface mined and coal in abundance is found without going to the expense

of sinking deep shafts. Convict labor is extensively employed, and plays quite an important part in the cheapening process. Organized labor views with displeasure and disgust this feature of their industries, but to this date has not been able to formulate plans whereby the convict labor nuisance might be abated, and it will be some years, perhaps another decade, before southern people as a whole are educated to a recognition of the fact that only free labor should be employed. All talk about correcting the evil at once and by radical means is simply a waste of time and not uttered by people acquainted with prevailing conditions.

Another factor in the cheap production of pig iron is the fact that 95 per cent of all the laborers employed about the furnaces are negroes—another form of cheap labor. Yet, though it is cheap, the past has proven beyond the shadow of a doubt that negro labor is far superior to and can successfully compete with the third class immigrants employed in such large numbers throughout Pennsylvania.

The question has often been raised why not supplant the negro labor with white labor? The reply is that no white man could do the work for any length of time in a southern furnace where climatic conditions make hard manual labor exceedingly trying. So that it seems certain, for furnace and kindred work in the South, negro labor is necessary and will continue to be employed as long as iron is produced in southern valleys.

Iron made in Alabama finds its way to all parts of the world. High prices, it is true, has temporarily lessened the export trade, but this has been more than counterbalanced by the increased home demand to such an extent, indeed, that orders can not be filled on time. At one time northern foundrymen had a strong prejudice against southern brands but that has been swept aside. Southern irons have established a reputation and are here to stay and at no distant date, if not already, will play the leading part in the iron production of the world.

As I have already said, nearly all of the machinery used in southern industries, except that covered by patent rights, is now made in the South, and there is also a growing demand for jobbing work. Molding machines have as yet not found their way to the sunny side of the Ohio river. The manufacture of cast iron pipes of all sizes is conducted on an extensive scale and a new syndicate is at present erecting a pipe plant at Bessemer, Ala., which, when finished, it is said, will be the largest in the world, and as they will operate their own furnaces they will be in a position to compete with anybody.

The stove trade of the South has seen a most radical change. The days when everybody prepared their meals on a long-legged skillet in the open fire-place have passed, except in remote mountain districts where one may still find relics of ante-bellum cooking. But even the poorest "nigger" wants a cook stove to-day. Cheap grades naturally are in greater demand, but the well-to-do people and middle classes are asking for better grades of stoves as is evidenced by the changes in the character of the stoves turned out by our southern shops. Compared with the stoves of ten years ago a great difference is noticeable. Better work and nicer finish is demanded, and in our larger cities a demand for furnaces is arising. But there is still a wide field for improvement and a good market open for enterprising stove manufacturers.

As to molders' wages, statistics will prove that there is very little difference from those paid in the northern shops. Machinery shops pay day work, and all well regulated shops under our control fix the price at $3 per day, although some jobbing foundries go down as low as $2.25. Pipe foundries do not employ molders, except to make the pipe fittings and iron flasks. There is but one malleable shop in the South—Chattanooga—and no steel foundry. The wages paid in them are ten per cent lower than what is paid for similar work in the North. All stove works run on the piece-price system and by careful competition it is calculated that the average wages is about $3 per day, leaving out of this calculation one non-union and one negro shop—two eyesores to every true member of our organization.

Foundries of all grades are rapidly filling up with "home guards," native boys who have served their time in the shops and are taking the places of those who came here to take up a temporary residence. We can not attempt to draw comparisons and say which is the better molder, for, although we can not turn out the high grade of castings turned out by the leading foundries of the

North, we have to do more hard molding and to be more of a general all round man than a molder of the same class working in the classified and specialized northern concerns.

One laudable feature of most southern foundries is the absence of bull-dozing foremen, and consequently more friendly relations between employer and employe.

The question has frequently been debated among northern stove men why the South can manufacture stoves cheaper than anybody else. To answer this conclusively it would be necessary to consult the manufacturers' computation sheets, but as these are not accessible, I will advance a few reasons that occur to me: Wages for molding and mounting are practically the same in both North and South, taking the weight of the stoves into consideration and figuring on a tonnage basis. A slight difference in favor of the South is found in the wages paid to foundry laborers, but the greatest advantage is found in the price of raw material, on account of the close proximity of southern foundries to the furnaces. Freight charges for iron, coal and coke are reduced to a minimum, while freight rates on finished goods over the southern roads are on an average, 17 per cent less than the same class of freight over eastern roads, thus enabling southern manufacturers to ship their goods even across the Ohio and compete successfully in northern markets. Nickel trimmings are not used to any extent nor is there any demand for fancy hollow-ware.

Without any exaggeration, we feel justified in making the assertion that the entire South is on the threshold of an era of unexampled development. The unrivaled output of pig iron from our blast furnaces and the upward tendency of the price of our main staple cotton, assures it. Northern capital is flowing southward and taking advantage of the opportunities for investment as they are offered, and before many years elapse Birmingham, Ala., and vicinity, we venture to say, will rival such great northern centers as Cleveland, O., and Pittsburgh, Pa.

The building up of these industries will, we hope, bring many members of our craft —emigrants from northern states—under the blue, southern skies, who will prove valuable acquistions and will help to build up the small, scattered unions of the South. Molders coming down here to-day will not find the poorly regulated boarding houses and ill-kept stores of ten years ago. Times have changed, progress has been made on every hand, and any well-behaved man will find himself made welcome among southern people. The cost of living varies with location, but the average differs little from similar communities elsewhere. The climate is very cheap and most all the shops running every day, closing down only for repairs or annual inventory.—H. M. Shellenburg, in Iron Molders' Journal.

The Royal Japanese Steel Works.

Nothwithstanding the plentiful occurence of iron ore in Japan and the considerable lapse of time since the first iron works was erected in that country by David Forbes (in 1875), the far greater proportion of the iron and steel consumed is still imported. Recently, however, it was decided to erect a steel works, at the expense of the state, at Yawatamura on the shores of the harbor of Wakamatsu (Fukuoka), about ten miles from Shimonseki, the site of the works covering an area of over 200 acres. The harbor near the quay has been deepened by dredging, so that there is about twenty feet of water at low tide. Water is laid on to the works, through a main, from the River Itabit, which is able to supply 660 gallons per minute when it is lowest, and double that quantity when full, and there are also a couple of reservoirs on the premises. The loading place is connected by a series of tracks, with all parts of the works and with the Kuishu railway, the total length of track at present being about ten miles, to which will be added a further length of four miles by the time the works are completed.

Installations for the supply of power by steam, electricity and hydraulics are provided, the waste gases from the blast furnaces and coke ovens being utilized for generating the whole of the steam, except in the locomotives. Altogether there are fifty-two boilers with a total efficiency of about 10,000 horse power, and twenty-four steam engines capable of developing an aggregate of 31,200 horse power, a 1,500 horse power electrical plant, and a 200 horse power hydraulic plant.

A portion only of the crude iron treated is of native origin, it being proposed to deal with but a small proportion of phosphorus—from Kamaishi, about 1,000 nautical miles distant from the works; together with phos-

phorus-free haematite from Akadani (450 miles away), and from Sennin (870 miles off), and Chinese magnetite and limonite from Tajeh and Hupeh (1,100 nautical miles distant). The coal is in the neighborhood of the works, and is said to furnish a good coke; it will be treated in a washing plant capable of dealing with about 1,200 tons per twenty-four hours, whilst 200 coke ovens, with mechanical dischargers and twenty-eight boilers, are provided for coking. The plan of the works was prepared by F. W. Lurmann, of Osnabruck, and the iron work is supplied by the Gutehoffnung Smelting Works at Oberhausen.

At the front and rear of the blast furnaces are two standard gauge tracks for removing the molten iron and slag; and in the rear are the electric charging-lifts, behind which again are two narrow gauge tracks for the coke cars. Then follow two sets of roasting furnaces, of the modified Westmann type, 34 feet high, heated by gas and dealing with 40 tons of ore per twenty-four hours day. Parallel to these furnaces are storages, over which, at a height of 26 feet, run three sets of normal gauge tracks, on to which the trucks laden with limestone and ore are pushed by engines up an incline (1:45) and then discharged.

Two blast furnaces are being erected. These are about 75 feet high, and capable of producing 165 tons per diem (twenty-four hours). The blast engine house, 73 yards long by 24 yards wide, contains four compound horizontal engines, with the following dimensions: Diameter of high pressure cylinder, 35½ in.; of low pressure cylinder, 51 in.; of the air cylinders, 75 in.; in common stroke, 60 in.; speed, thirty-four revolutions per minute; total air supply, 18,100 cubic feet per minute; pressure, 0.7 atmosphere; total indicated horse power of the engines, 850; consumption of steam, 17¾ lb. per horse power hour. A 10-ton crane is also provided. The eight blast heaters are of the Cowper (stone) type, each being 98 feet high and 20 feet in diameter; the gas conduit is 80 in. wide and 765 yards long, the hot air pipe being 60 in. outside diameter and 207 yards long, and the cold air pipe 40 in. wide and 175 yards long. There are twenty-four boilers, each measuring 88 in. in diameter and 36 feet in length, with two 32 in. tubes, the heating surface being 1,038 square feet, and the steam pressure 8½ atmospheres.

The casting house consists of two iron [illegible] 130 feet long by 65 feet wide, and containing two casting pits. The condensing [illegible] consists of an enclosed twin surface condenser capable of treating 1,034 lbs. of steam per minute, together with a pair of electric air pumps, an electric condensing-water pump, and a wooden cooling tower for sea water.

Between the blast furnaces and the steel works are two 160-ton mixers tipped by hydraulic power, and two 200-ton cupola furnaces. The converter house is fitted with two converters of the American type 19 feet high, 10 feet wide, and with a capacity of 460 tons each per twenty-four hours. The horizontal compound blower-engine for the Bessemer works measures: Diameter of the high-pressure cylinder, 78 in.; of the low-pressure cylinder, 67 in., and of the air cylinders, 63 in.; stroke, 59 in.; volume of air dealt with per minute, 14,126 cubic feet, pressure, 2.2 atmospheres; indicated horse-power, 1,600; consumption of steam, 17·6 lbs. per horse-power hour.

There are also two cupola furnaces for spiegeleisen, a 20-ton electric traveling crane, three 15-ton casting ladles, etc. Four 25-ton Martin furnaces are also projected, the hearths measuring 20 fet long by 9 feet wide, the total length of the furnace being 41 feet, width 21½ feet, and heighth 28½ feet. Each furnace is expected to produce 50 tons in twenty-four hours. There are twelve bottom-draught generators, a Wellman electric charging apparatus, a 50-ton electric casting crane, two 30-ton casting ladles, etc., and a workshop fitted with ten cold-saws, sundry lathes, drying chambers, warming ovens, etc.

The block rolling mills comprise a heating-furnace house 65 feet long and 39 feet wide, fitted with seven furnaces heated by generator gas, hydraulic opening and closing appliances, and a 3-ton electric crane. The rolling house, 223 feet long and 65 feet wide, contains a rolling mill, with rollers 9 feet long by 3½ feet in diameter, driven by a 4,000 horse-power horizontal double-cylinder engine; there are also a 25-ton and a 10-ton crane, with a steam hydraulic shearing machine for dealing with red-hot blocks up to 12 in. side. The rail mill is driven by a 500 horse-power triple-cylinder horizontal engine, and in this building are also an electric hot-shearing machine, four electric turning machines, sixteen electric borers, and a 10-ton

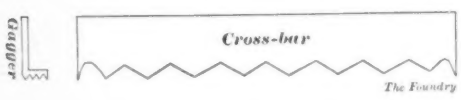
crane. Coarse and fine rolling mills for bar and sheet metal are also projected.

The central pumping station contains two air pumps, two condensed-water pumps, two pumps for the blast furnace condensing plant, and two for the hydraulic accumulators supplying 220 gallons per minute at 50 atmospheres pressure. Two other accumulators, a Linde refrigerator, and a condenser are also provided, together with a water main 380 yards long, and a drain 317 yards in length. The central electrical station is fitted with two 250-volt 380-kilowatt continuous current dynamos, a small dynamo (250 volts, 166 kilowatts), 120 accumulators, a switchboard, and three steam engines. Other branches of the works include a repairing shop with electrical machinery, a casting foundry, molding and modelling shops, smithies, laboratories, etc., and two 1½-ton portable cranes for loading, a 24-ton quay crane, and a 10-ton mast crane worked by hand.

It is expected that one of the blast furnaces will be ready for work by April or May next, the other about two months later. The anticipated yearly output amounts to 35,000 tons of rails and 10,000 tons of rods from the Bessemer works, and 25,000 tons of sheet metal, 15,000 tons of molded goods, and 5,000 tons of rods from the Martin furnaces, a grand total of 90,000 tons.

Cast Iron Cross Bars and Gaggers.

The advantages of the style of crossbar and gagger here illustrated ought to be apparent to the practical molder at a glance. I have affixed the names of the things that I wish to represent, on the sketches, lest the reader should take the one for a cross-cut saw and the other for—something else. I have practiced making iron crossbars after the fashion here illustrated for many years; but not till recently did I ever see a gagger



made on this plan. The gagger made this way will hold the sand on the bottom side better than where the bottom surface is flat, there will be less liability to scab, and it will not be so apt to produce an unsightly scar on the surface of the casting. The same may be said of the crossbar. But these are not the only advantages pertaining to this bar. If this cross bar is properly constructed there will be no need of tucking the sand under it, when used on light work, even though no peening be done here; and on heavy work, which requires that the mold be peened along the sides of the bar, there is still less need for tucking. In case the bar approach too near to the pattern or any piece that is molded in the flask, it is a very easy matter to break off one or more of the points, whereas, with the ordinary bar, resort must be had to chipping and grinding. It is not at all uncommon to see iron crossbars that were cast with numerous perforations, for the purpose of reducing weight. In this bar the weight is modified by the shape of the edge, the body being left solid, for strength.—E. H. Putnam, in The Tradesman.

An Unusual Shrink and its Remedy.

We have all had more or less acquaintance with shrinkage, occurring as it does in almost endless variety. A recital of the following case, its cause and cure, may be of interest to a number of readers.

Shrink holes usually come in the top or cope side of a casting, and as the one referred to developed in the bottom or nowel side, it attracted more than ordinary atten-

tion. The writer was working on the job at the time and was considerably puzzled as to what could cause a shrink on the bottom of the casting. After some study of the case we became convinced that the trouble lay in the proportions of the pattern not being well enough balanced to produce sound castings.

The casting was a lathe bed, and to better explain the case, a rough sketch is shown. Fig. 1 is a cross-section of the bed through one of the ties, A A A being the outline of the core. The cross-section shows relatively the proportion of the parts, and we notice at

once the disparity as between the upper part or frame of the bed and the tracks. Fig. 2 is a cross-section of the tie or pockets that unite the sides of the bed. After pouring, the upper and lighter part of the casting would set before the heavier tracks, so that when the tracks were shrinking there would be nothing from which they might feed, hence the shrink hole as indicated at C, C (Fig. 1). The bed was always gated into the track, so that when the mold was full the iron in the tracks was hotter and more fluid than in the upper part of the mold, which set some time before the tracks became solid. Until the upper part set it would feed the tracks, but afterward, as I previously pointed out, they would be without riser or feeder and in setting would show a shrink hole or a very coarse grain at C (Fig. 1). The shrink would not show until the tracks were being planed, when, after making a cutting of from one-eighth to a quarter of an inch small holes would sometimes show about half an inch wide and from five to six inches long, or else the grain would be so coarse that it would be impossible to produce a fine polished surface. After some experimenting we finally determined to increase the thickness of metal beneath the tie cores, and cut off part of the core as shown by dotted line, B (Figs. 1 and 2)—when the tie core was about ten inches deep it was my custom to cut off about four inches—and afterward was not troubled with the shrink above referred to.

Now, let us briefly examine the philosophy of our remedy. If the tracks were cast separate and a shrink should develop it would appear on top or cope side, but in the bed the sides would feed the tracks until they set, by which time the upper part of the tracks would also have solidified, hence no shrink would develop in the upper surface, but would be transferred lower down where shrinkage had not yet ceased. Now, by increasing the thickness of the lower side of the tie, we placed a body of fluid iron directly over the tracks which acted as a riser, and fed them until they became set, and the shrink hole or coarse grain disappeared.

That was our experience and our remedy, and if others have had a similar one I should like them to make it known, especially if they hit upon some other way of effecting a cure.—F. von C. in Iron Molders' Journal.

Developed in Connecticut.

Winsted is to have a new industry in the shape of a hardening furnace and a large plant is to be erected on Willow street, near the Naugatuck station, this spring. Work will be commenced just as soon as the frost is thoroughly out of the ground. Back of the movement are Egbert H. Northrop, of New Milford, and John C. Carroll. Mr. Northrop has invented a process for hardening cast iron rolls which is a great labor, time and money saving process over the old chilling process now in use at all the large iron and other metal working plants.

For example, for making chilled iron rolls used in rolling out all kinds of metal into bars or sheets the old process is to take a soft or sand iron roll and to chill it by subjecting it to a mass of intensely heated iron and then letting it cool and later cutting it down to the required size by the use of very expensive steel tools, making a slow and costly process.

It frequently happens that after a vast amount of labor has been expended it is found that the core of the iron roll thus chilled has separated or cleaved from the outside shell, in cooling, and the roll is thus useless.

Mr. Northrop says that by his secret process the soft or sand iron rolls are taken from the furnace and put in a big vat containing a solution and are chilled immediately and much harder and better than by the old process. It is all done in a short time and when cooled they do not need to be cut down as they can be molded into the right size to start with.

Thus it will be seen that an immense amount of labor, time and expense are saved and a better roll is procured in the end, as the solution not only hardens the roll but strengthens and refines it and no special steel tools are required.

It has not been fully decided yet just as to the number of furnaces and secret solution tanks that will be put in but they will be built as the requirements of the business demand.

Mr. Northrop is receiving many samples of iron to be chilled by his process and some orders have been sent in. Among others the Farrel Foundry Co., of Ansonia, has sent a sample of iron to be chilled. A large firm in Ohio has already made the request that a branch furnace be built in connection with its plant.

The matter resolves itself down to the one point that the Northrop process is a great money saving invention and Mr. Northrop expects that in the near future all the large metal working concerns will make use of his process.—Ansonia (Conn.) Sentinel.

If.

If the Doherty process is found in general practice to realize anything approaching the results obtained in certain published tests, then it is unquestionably one of the greatest improvements of the present day in the melting of cast iron. It simply means imparting to cast iron, or castings therefrom, some of the qualities, in greater or less degree, of malleable iron. It enables the ironfounder to produce superior castings from iron of inferior quality. A good test of the ductility of iron is to cast it in the form of thin plates and punch it with holes close together by means of an ordinary punching machine. According to a pamphlet which has been issued by the London office of the Doherty Company, Arundel street, W. C., the secret of the process is "the application of nascent hydrogen to the melting iron." That is hardly sufficiently intelligible, and we may state that the system is carried out very simply, in an ordinary foundry cupola, with but little structural alteration. The fittings required are merely a few lengths of steam pipe with valves, and a superheater of special form. Dry steam is admitted to the cupola along with the blast and in varying quantities at a certain period of the blow. The steam is decomposed by the hot fuel on which it impinges into its constituent gases, oxygen and hydrogen. The result is a material increase of the temperature of the furnace, while the hydrogen tends to the purification of the metal. Any oxide of iron in the form of rust is reduced to the metallic state instead of accumulating as slag. The steam used must be dry, and to ensure this it is passed through a superheater placed close to the cupola; thus it is quite possible to use low pressure steam when necessary, and to bring it long distances. The advantages claimed are that it effects a saving in cost of production as well as improvement in the quality of the castings produced. Not only is less coke required, but coke of inferior quality having a high percentage of sulphur can be used without detriment to the metal, for the sulphur seems to be eliminated by the process. And as the molten metal leaves the cupola at a higher temperature than is usually attained in ordinary practice, there is less risk of faulty or spoiled castings. In addition to the tests for ductility referred to above, many tests have been made as to the tensil and transverse strength of the iron, and without going into details we may say that the increase of strength averages from 17 to 44 per cent. We understand that already some ironfounders in this country who have satisfied themselves as to the merits of the process have taken out licenses for its adoption, and we await with interest some further reports of the effect it has had upon the foundry business generally.—Trades Journals Review.

News from the Trade.

The J. S. McCormick Co. of Pittsburg, write us that after considerable prospecting they have discovered a mine in Tennessee from which they secure a blacking, which for use on dry sand, loam work and cores is superior to the imported Ceylon plumbago. It has been tried by some of the largest foundries and pronounced of the best quality. This blacking has been named the "Vulcan" Blacking by the McCormick Co.

The Chicago Pneumatic Tool Co. has issued a special edition of testimonials received by them from a great variety of trades. The letters are reproduced in facsimile and the book, containing 160 pages, forms a novel feature in advertising.

The Hanging Rock Iron Co. succeeds the firm of Means, Kyle & Co. at Hanging Rock, Ohio, and thus the well-known Hamilton furnace passes into other hands. Rogers, Brown & Co. have been appointed sole selling agents of the product of the Hamilton furnace which will be standard Bessemer, coke malleable, special car wheel and high grade foundry irons.

Henry Maurer & Son, 420 East 23d st., New York, have issued a booklet describing their "Herculean" Terra Cotta Blocks.

The Chicago Pneumatic Tool Co. have offered all purchasers of Boyer Piston Air Drills to equip these with the improvements which have been made since the sale was made. This offer is unique and shows the care the Chicago Pneumatic Tool Co. exercises to give its customers the best service within its power.